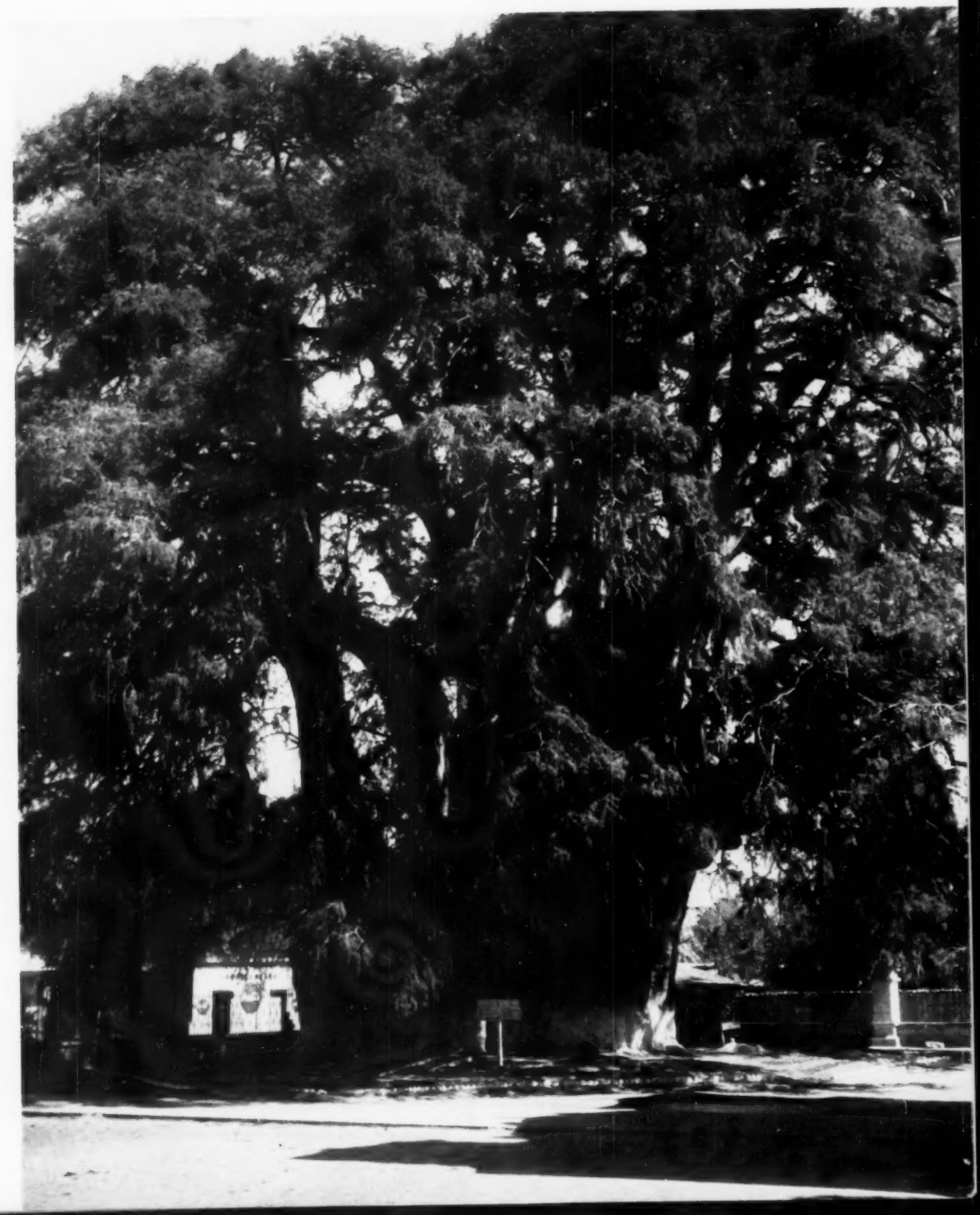
Journal of FORESTRY

June 1957



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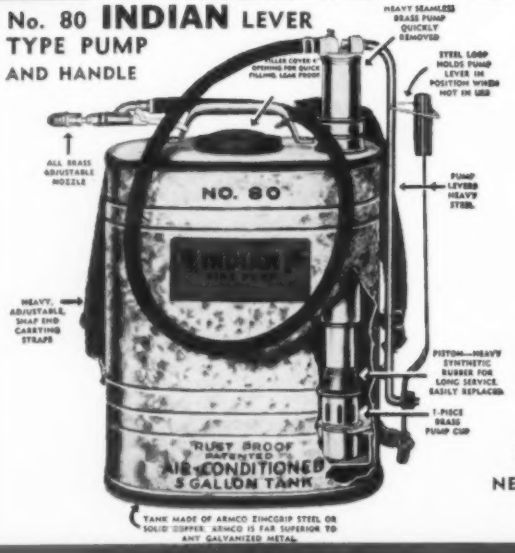
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Journal of Forestry

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The Relationship of Jet Streams to Forest Wildfires

Vincent J. Schaefer
The Munitalp Foundation, Inc.,[1]
Schenectady, New York

AMONG the most terrifying of all natural phenomena is wildfire in the forest. Travelling with the wind, sweeping through the treetops and scattering flaming brands far ahead of the main body of the fire, this type of forest fire is dreaded by all who know the forest and the problem of fire control.

The presence of ancient fire scars in the forest indicates that wildfire is not necessarily a recent phenomenon (*10*). It is probably true, however, that the increased number of fire sources introduced by the presence of roads and other forms of human activity, together with the increased fuel sources from ever accelerated lumbering operations, serve to make the potential for the formation of blow-up fires greater than it was in the primeval forest.

It is gradually becoming recognized that a number of meteorological conditions combine to establish the environment that is associated with blow-up fires. A prolonged rise in the burning index (*1*), the onset of local subsidence (*5*), and the presence of a jet current (*2*) lead to serious fire hazards in grass, brush, and forest areas. The hot, dry winds which result from these two latter conditions lead to an explosive situation which requires only a tiny flame to start a holocaust against which even our most modern fire fighting equipment is quite ineffectual.

Over the past eight years while studying natural phenomena in various parts of the world, I have noticed certain atmospheric features which repeat themselves time and again and which must be intimately associated with the occurrence of wildfire. In a number

[1] A privately endowed organization dedicated to basic research in meterology and an original cooperator, with the Intermountain Forest and Range Expt. Sta. in 1953 in "Project Skyfire."

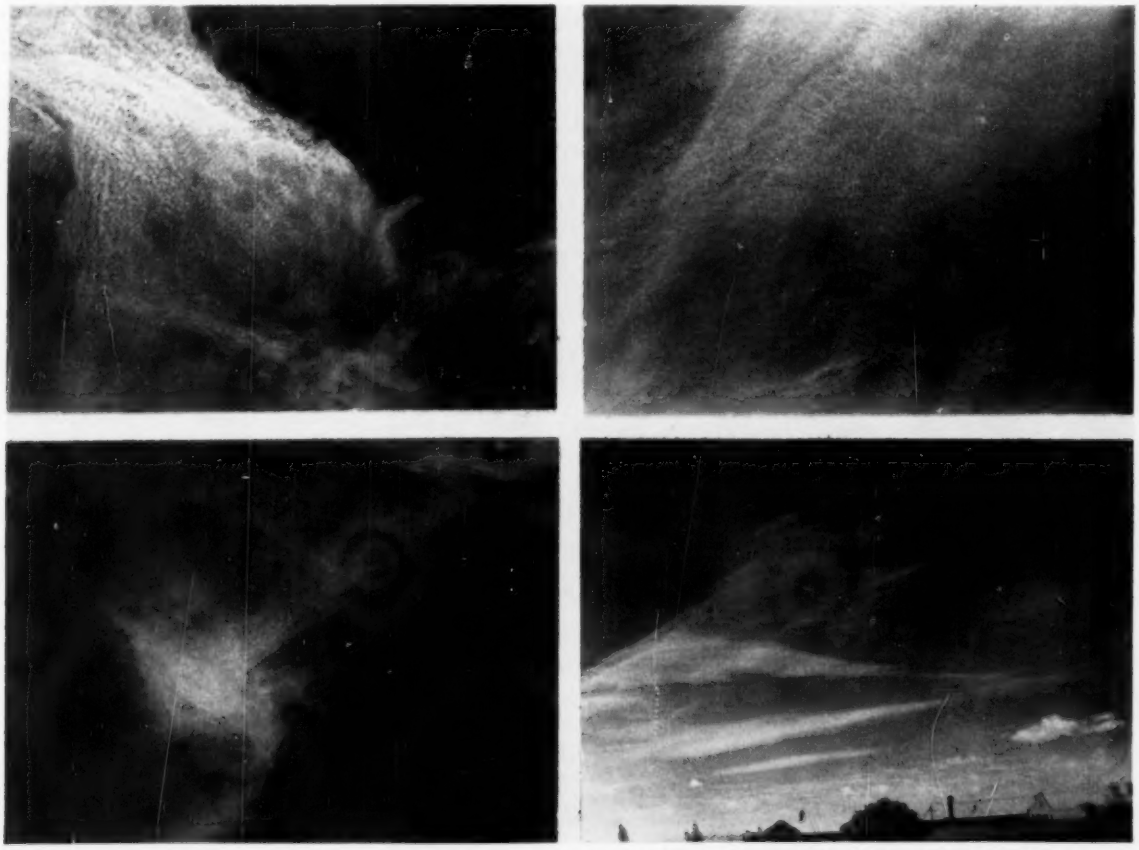

FIG. 1.—Classic forms of high level cirrocumulus wave in jet stream. Socorro, New Mexico, May 1, 1955.

of the cases observed, fire did not occur, although the tiniest flame could have produced devastation.

Gusty Ground Winds Related To Jet Streams

The essential phenomenon was originally listed by me (*7*) as one of four characteristic features useful in detecting and locating the presence of a high-level jet stream. It was pointed out that even though the high velocity core of a jet stream was at the 25-35,000 foot level, strong gusty winds were often observed occurring at ground level at periodic intervals. It was also pointed out that this condition was noted most frequently when the air in the lower levels of the atmosphere was unstable. A possible relationship of these gusty winds to forest fire behavior was mentioned.

About four years ago I noticed in the northeastern United States that certain uncontrollable grass fires, local "fire devils," and sudden squalls on lakes occurred under similar conditions. At about the same time I was shown some cloud pictures taken by an Air Weather Service meteorologist while in northern Greenland at a time when winds at ground level were said to exceed 100 miles per hour. The clouds pictured were classic examples of jet stream clouds including spectacular high-level waves.

In comparing observations of gusty low-level winds with Captain Bernard Frost, who has developed techniques for locating and flying in jet streams (*4*), I found that he, too, had noticed the same relationship to jet streams both in Europe and over the North Atlantic. Above the ocean the winds were observed to form intense local squalls as indicated by the appearance of the sea.

Time lapse photographs of typical foehn conditions over the Austrian Alps taken with time lapse cameras from the Hohenpeissenberg Observatory in Bavaria and at Bishop, California and others associated with the williwas north of Labrador all combined to emphasize the probable relationship of low-level, warm, dry, gusty winds and a high-level jet stream. During the past two years, further relationships have been noted in the field. A few typical examples will be cited.

Examples of Gusty Wind Occurrences

On the evening of May 1, 1955 gusty ground winds of the type associated with the jet stream effect were noted near Socorro, New Mexico. The next morning a series of highly spectacular high-level wave clouds with cirro-cumulus patterns of classic form were observed overhead and northeast of Socorro. Figure 1 illustrates some of the cloud areas seen. That afternoon a dust storm reputed to be the worst in local history occurred in the vicinity of Estancia, New Mexico. Before the dust storm occurred, a highly unusual "cloud" of positive ions was recorded at the research institute of the New Mexico Institute of Mining and Technology.

During the second week of July 1955, while at Louis Lake, Wyoming at 10,000 feet in the Wind River Mountains, a similar sequence of events was experienced. For most of the night of July 7 a strong, gusty wind estimated to reach velocities up to 50 m.p.h. was noted. At 0800 hours a corona current of + 0.110 uA was measured, using a radioactive probe (*9*) mounted on a 30-foot mast. The maximum current flow coincided with the highest gust velocity. The corona current remained high, however, even after the gust ended and only then slowly decreased in volume. The impression gained was of a dense "cloud" of positive ions carried to near ground level by the gusty wind and then dissipated by combination with negative ions or by flowing to earth. Three hours later a series of isolated, high-level cirro-cumulus waves of classic form similar to Figure 1 developed just east of the southern end of the Wind River Range. High velocity winds at cloud level continued throughout the day. The relative humidity was estimated to be less than 5 percent and the sky had the intense blue associated with strong subsidence of stratospheric air. The following day further evidence of the presence of a jet stream was observed over the southern edge of Yellowstone Park, and on July 9 several small, high level, fast moving thunderstorms of the type associated with a jet stream (*8*) were studied and photographed at

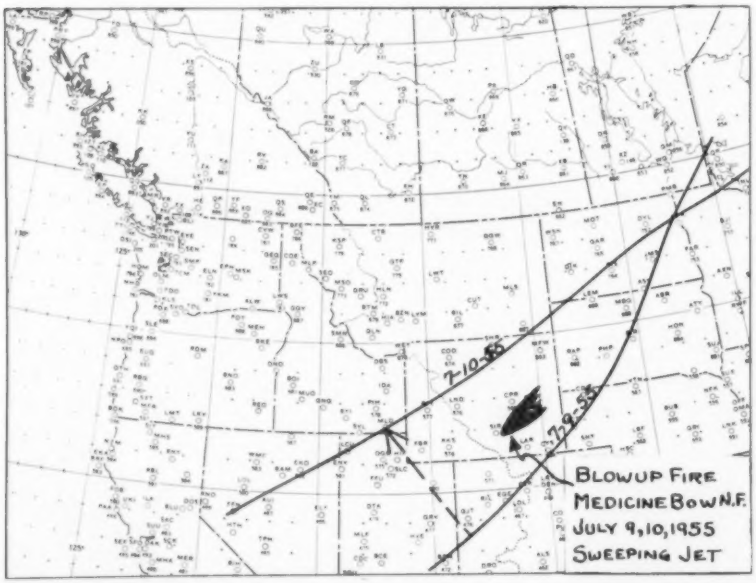

FIG. 2.—Swing of major axis of jet stream during blow-up of Medicine Bow Fires in Medicine Bow National Forest. July 9-10, 1955.

the summit of Mt. Washburn in Yellowstone Park. On this same day the Rock Creek fire in the Medicine Bow Mountains of Wyoming "blew up" and southwest winds at the fire had recorded velocities of 44 m.p.h. In an extremely interesting account of the local weather observed at the vicinity of this fire, Krumm (*6*) pointed out that the dewpoint of the air as measured at nearby Casper, Wyoming was -25°C on July 9. Although the jet stream was not mentioned as playing a major role in producing the subsidence of dry air which occurred during the blow-up period, he ascribed the extreme dryness of the air to the fact that it had recently been in a very cold region of the atmosphere.

Information on the center of the jet stream maxima prepared by SELS[1] of the United States Weather Bureau in Kansas City showed that during the blow-up period the axis of maximum high-level jet stream winds swung across Wyoming, pivoting at a point near Grand Forks, North Dakota, with its southwestern center moving from southeastern to northwestern Utah in 24 hours as shown in Figure 2. This pattern of behavior seems to be a common feature when gusty ground winds occur which are related to high-level jet streams.

The Formation of Bénard Cells In Jet Streams

By extensive field observation of jet stream clouds and jet stream situations ranging from those whose major axis persists for extended periods in one geographic location, to those which sweep across an area at high velocity, I have developed concepts of the air motions which occur under a number of different conditions of the atmosphere. These ideas are based entirely on visual observations in the field without resort to the benefit of soundings or other quantitative information. Many of these effects are so transient and localized that they will not be noted on any regular weather map. However, I am reasonably sure that a careful study of available soundings supplemented by a few special observations will establish the reality of these atmospheric motions.

The primary atmospheric structure which I believe is associated with the development of gusty ground winds in connection with a high-level jet stream and the occurrence of conditions favorable to the development of forest wildfire is the horizontal Bénard Cell. This assumes the form of a large, horizontal spiral having a diameter which may exceed 6,000 feet. Clem (*3*) has proposed an atmospheric model which approximates the formations indicated by some of the cloud patterns I have observed. The ribbed cirrus illustrated in Figure 3 could be produced by this type of movement occurring at the top or bottom surface of a stable, moist layer in a jet stream.

It should be remembered, when looking at a typical cross sectional diagram of a jet stream made at right angles to its major axis, that the horizontal and vertical scales ordinarily used by meteorologists are in miles and feet respectively. Thus, to illustrate the true cross section of a jet stream having a width of 60 miles and a thickness of 20,000 feet, it is necessary to draw a line an inch long and 1/16 inch thick. Such a diagram emphasizes the fact that a jet stream is essentially a very thin ribbon of air. Interfacial phenomena are likely to dominate such ribbonlike streams. Among the structures likely to be of common occurrence are Bénard Cells, since they are essentially products of temperature differences and air motion. It is also likely that there will be a considerable number of such cells of varying dimensions and detail. The cloud patterns in jet streams, as well as condensation trails from high-flying aircraft, often depict these structures in excellent detail.

The Dudley Lake Fire, A Classic Example of Wildfire

On June 14, 1956 I had an unequalled opportunity to observe, study, and record a classical example of wildfire in a forest. On the day previous an undetected spark started a fire in the midst of a lumbering operation at Dudley Lake in the Mogollon Plateau region of northern Arizona. Although a large number of men and an assemblage of bulldozers and

FIG. 3.—Classic form of ribbed cirrus forming at top of Bénard Cell in jet stream maxima.

[1]Severe Local Storm Warning Center.

other heavy mechanical equipment were available, the fire spread unimpeded and on the 14th, driven by a strong, gusty ground wind, it ran as wildfire over more than ten miles of mature ponderosa pine forest. Despite the efforts of a thousand firefighters, a host of mechanical equipment, and easily accessible terrain, the fire finally burned itself out when it reached the northern edge of the forest and ran out of fuel. Figure 4 indicates the pattern of the Dudley Lake fire.

On the 14th, in company with J. Dieterich, I was able to watch its major run from the Dutch Joe lookout tower close to the western edge of the fire. The day was cloudless except for a few thin, fast-moving cirrus in the southwest and some spectacular wave clouds over the San Francisco Peaks to the northwest. The relative humidity reached a low of 4 percent by midmorning when the dry bulb temperature read 31°C. Throughout the day the ground wind ranged between 35 and 50 m.p.h. A zero lift balloon released at 1500 hours from the lookout tower moved in such an unvarying trajectory that after the first two minutes it was not necessary to adjust either the elevation angle of 6.5° or azimuth angle of 218° until the balloon was lost after 7¼ min.

More than 200 feet of time lapse movies of the fire were taken between 1100 and 1700 hours. Exposures were made at 2-second intervals so that when projected at 16 frames per second the sequences are speeded by a factor of 32 times. As a result, the air motions in the vicinity of the fire are seen in a spectacular manner.

These time lapse movies show that the western side of the fire was dominated by a huge Bénard Cell having a diameter of about 6,000 feet rotating counter-clockwise in the down-wind direction and making a complete rotation in about a mile.

The smoke which delineated this cell stayed within it to the distant horizon. Subsequently, I learned that it remained as a coherent, streaming mass at least to the Mesa Verde National Park over 300 airline miles to the northeast.

Although the wind direction remained fixed within narrow limits, it occasionally varied by a few degrees. This may have been controlled by the rotational features of the Bénard Cell. At regular intervals the smoke roll would move outward and for a short period hide the active edge of the fire. This was invariably followed by rapidly moving crown fire which would sweep another narrow line of big trees several miles in length. In this manner the fire gradually widened its devastation. This effect was made highly spectacular by the lines of black smoke which would suddenly emerge from the active fire accompanied by towering flames. Thus, although large amounts of the products of combustion would be carried by the rotating cell back into the flames, enough fresh air was entrained with it to keep the fire going as a highly vigorous conflagration. Due to the crowning effect, fire lines along the edge of the fire were ineffectual during this active phase of the fire.

Although the strong winds continued into the night, the Bénard Cell structure was no longer visible on June 15. The relative humidity also reverted to its more normal value of 20 percent at midmorning when the temperature was 22°C, or 9°C colder than the previous day.

FIG. 4.—Typical fire pattern which occurs when the jet stream drives a blow-up fire. Dudley Lake Fire, Arizona. June 13-15, 1956.

TABLE 1.—JET STREAM RELATION TO LARGE BLOW-UP FIRES IN WESTERN FORESTS DURING 1955 AND 1956

Fire	Forest	State	Blow-up date	Total acres burned	High level jet velocity	Type
			1955			
Johnson	Prescott	Arizona	July 8 & 9	19,116	60-75 knots	Sweeping
Rock Creek	Medicine Bow	Wyoming	July 9 & 10	600	60-75	Sweeping
Shell Rock Spgs.	Malheur	Oregon	Aug. 18 & 20	9,600	90-100	Sweeping
Deming Creek	Fremont	Oregon	Aug. 22	2,500	90-110	Sweeping
Deer	San Bernardino	California	Sept. 27	2,950	50-60	Sweeping
			1956			
Osceola	Florida	Florida	Mar. 24 & 27	50,000	70-95	Conflict
Pendleton	Lincoln	New Mexico	Apr. 26 & 28	5,825	80-115	Sweeping
Admiral Lake	Ontario	Canada	May 21 & 23	69,000	80-120	Sweeping
Bob Tail	Tonto	Arizona	June 8 & 9	3,990	50-75	Sweeping
Nuttle	Coronado	Arizona	June 13 & 22	5,540	50-75	Conflict
Jerky No. 5	Hila	New Mexico	June 15	1,660	65-70	Sweeping
Dudley Lake	Sitgreaves	Arizona	June 14	21,389	50-60	Sweeping
Coche No. 2	Coronado	Arizona	June 14	2,300	55-60	Sweeping
Mingus	Prescott	Arizona	June 19 & 20	14,700	60-70	Sweeping
Davenport	Ashley	Utah	July 1	550	65-70	Sweeping
Sterling	San Bernardino	California	July 4	400	50-70	Sweeping
Serpentine	Klamath	California	Aug. 21	1,650	50-120	Conflict
Robie Creek	Boice	Idaho	Sept. 5 & 8	8,310	55-110	Sweeping
Refugio	Los Padres	California	Sept. 6 & 12	84,770	60-85	Sweeping
Cottonwood	Bridger	Wyoming	Sept. 20	1,003	45-60	Conflict
McKinley	San Bernardino	California	Sept. 21 & 22	10,210	55-65	Sweeping
East Highland	San Bernardino	California	Nov. 20 & 21	15,330	60-150	Conflict
Inaja	Cleveland	California	Nov. 24	43,900	65-95	Conflict

Values of Atmospheric Electricity and Condensation Nuclei at the Head of the Dudley Lake Fire

In the morning of June 15 a quick sally was made into the leading edge of the fire. Innumerable fingers of fire were encountered but much of this was confined to a ground fire that was creeping through the juniper and cedar growth marking the edge of the pine forest. Corona current measurements were made in this region. Values approaching those found in an active thunderstorm or snow storm were obtained. The highest values of +0.400uA were found to be directly related to the intensity of the smoke. When the smoke became so dense that it caused noticeable eye smarting, the values were +0.100uA. A portable General Electric condensation nuclei meter showed values in excess of $1x10^6$ per cubic centimeter under these conditions. Outside of the fire the corona current showed a maximum of +0.060uA and a nuclei count of $2x10^3$ per cc.

These high values of corona current are not entirely unexpected, since flames produce ionization. It is very interesting, however, that the high current readings were exclusively of a positive sign and were associated directly with the smoke density in the vicinity of the probe. This indicates that small ions produced in the fire became attached to smoke particles and caused these particles to carry a net positive charge for considerable periods of time. The smoke clouds producing the corona current had travelled for several miles before reaching our observation site. Further studies of atmospheric electricity in forest fires of various types should be made to determine whether these effects are of significance in relation to large fire phenomena. If possible, such measurements should be made beneath, as well as within, the smoke plume. Fires of the type represented by the Dudley Lake Fire will be the easiest to study in this manner since the dense smoke areas are sharply defined and easy to approach at the downwind position from the active fire front. Great care must be exercised in making such measurements, however, and an escape route should be carefully planned when such studies are attempted.

Blowup Fires and Jet Streams

It is unlikely that all cases of forest wildfire are related to the near proximity of a high velocity jet stream. Localized blow-up situations dominated by subsidence winds from air mass type thunderstorms cannot be included. Other situations probably can be explained in terms of purely local air drainage effects, chimney effects, etc.

However, a quick glance at atmospheric conditions accompanying some of the disastrous fires of the past two years, which made spectacular runs during a period of a day or two, show strong evidence that the effect is definitely related to the close proximity of a jet stream of a special type. In the most striking cases a study of the day by day location of the jet maxima indicates it was sweeping across the area where the wildfire occurred. It is quite likely that most of the big fires of the past, such as the 1910 fire of northern Idaho and western Montana, the Peshtigo Fire of northern Wisconsin, the Maine fire of 1947 and others of disastrous proportions made their runs under the impetus delivered to the low-level air by energy supplied from a high-level jet stream. Only something as energetic, as widespread, and as continuous as a jet stream could account for the extended periods of high winds which were necessary to serve as the initiating and driving force of these tragic occurrences. Even smaller, so-called

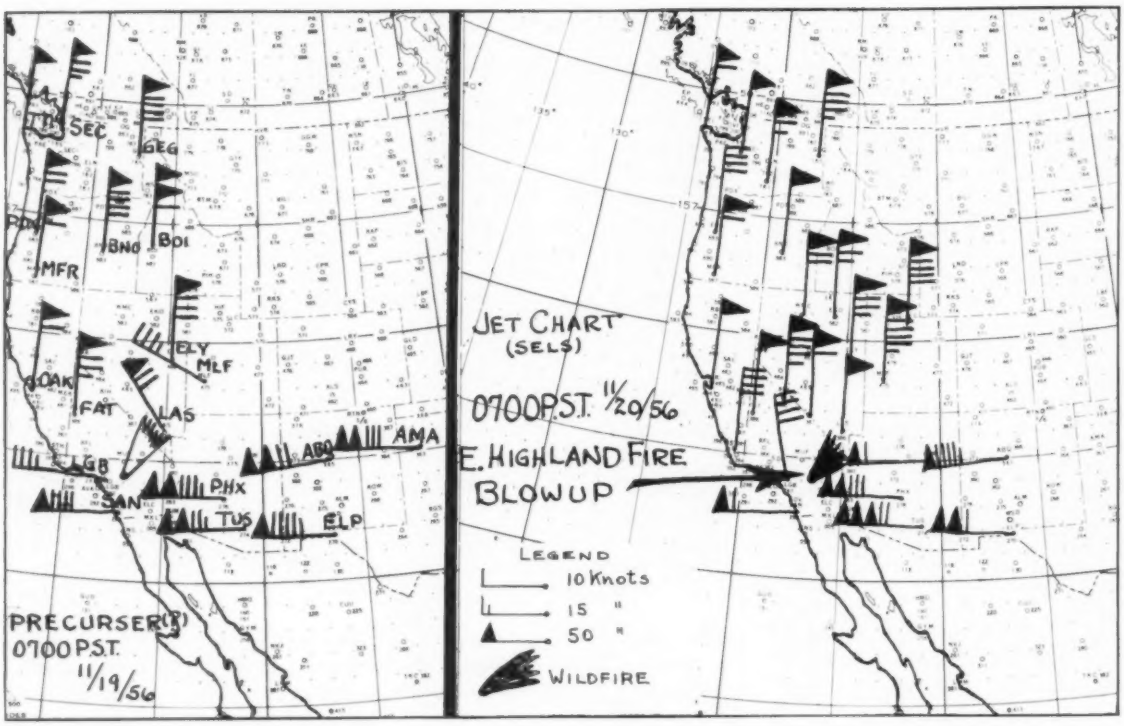

FIG. 5.—Jet stream pattern previous to and during blow-up of East Highland California fire.[1]

[1]The symbols represent wind velocity in knots. A triangle represents 50 knots, each long line 10 knots, and each short line 5 knots. Thus, at PHX, which is Phoenix, Arizona, at 0700 on November 19, 1956, the wind maximum in the jet stream was 135 knots; at Tucson on November 20, the wind was 170 knots.

The stations reporting upper winds and which are given in their official abbreviations are as follows:

TTI—Tatoosh, Wash.
SEC—Seattle, Wash.
GEG—Spokane, Wash.
PDX—Portland, Ore.
MFR—Medford, Ore.
BNO—Bend, Ore.
BOI—Boise, Idaho
OAK—Oakland, Calif.
FAT—Fresno, Calif.
ELY—Ely, Nev.
MLF—Milford, Utah
LAS—Las Vegas, Nev.
LGB—Los Angeles, Calif.
SAN—San Diego, Calif.
PHX—Phoenix, Ariz.
TUS—Tucson, Ariz.
ELP—El Paso, Texas
ABQ—Albuquerque, N. Mex.
AMA—Amarillo, Texas

local effects as typified by the Santa Ana winds of southern California are probably triggered off by this more massive atmospheric control mechanism. The Mistral, Williwa, Chinook, Sirocco, Foehn and similar intense localized surface winds all probably fit into this category.

Much more study should be directed toward understanding the physical mechanisms involved to discover the local evidence which might be used in the field to detect the onset of such a situation and to determine the success which might attend an attempt to forecast such developments.

Since effective fire control is most likely to succeed if the fire never starts, a reliable forecasting method would be of inestimable value in permitting reasonable access and activity in forested areas during periods of severe fire hazard and complete cessation of all activity during the brief but highly dangerous periods of low humidity and gusty ground winds.

The rapid advances being made toward this objective at present by groups such as those at the SELS Center and the fire weather forecasters of the United States Weather Bureau, research meteorologists of the U. S. Forest Service, combined with the development of an increased awareness of the value of an understanding of forest meteorology among those who use the forest for recreation or livelihood, should go a long way toward reducing the incidence of forest wildfire.

Table 1 lists the interesting relationship found to exist between blow-up fires and high level jet streams. This table includes 23 blow-up fires which occurred during 1955 and 1956 as listed for me by the Division of Fire Control of the Washington office of the U. S. Forest Service. The blow-up fires were selected only on the basis of periods for which I had jet charts available. In every case a high level jet stream pattern is

found to have existed in the closest vicinity of the fire during its blow-up period with an interesting and unusual dynamic pattern being discernible. A detailed study of each situation has not as yet been made, but even a casual inspection discloses two distinct patterns. The most frequent in occurrence (17 of 23 in Table 1), which might be termed the sweeping pattern, is the one in which the high-level jet stream maxima seems to pivot in a region several hundred miles or more up or down stream from the fire location. As the axis sweeps across the region where the fire is burning, the blow-up occurs. This pattern has been shown in Figure 2. The less frequent pattern is one which suggests a zone of severe conflict between two intense jet streams. In this category are the blow-up fires which are driven by the so-called Santa Ana Winds in southern California. I suspect that when sufficient data becomes available many intense so-called local storms experienced at ground level are triggered off by such conflicts in the higher atmosphere. A classic example is shown in Figure 5 which indicates the high-level jet pattern that existed just before and at the time when the East Highland fire of the San Bernardino National Forest made its disastrous run on November 20 in the late fall of 1956. It is likely that many extremely interesting relationships will be found as more intense study is directed toward these important phenomena.

Author's note: The writer is indebted to fire research and fire control personnel of the U. S. Forest Service in the western United States and the Washington office for assistance in supplying data on recent blow-up fires in the national forests. He is particularly indebted to J. S. Barrows, chief of fire research of the Intermountain Forest and Range Experiment Station who made the arrangements to accumulate the data and for the many discussions in the field as observational data was accumulated under Project Skyfire; to W. R. Krumm of the Missoula office and D. C. House of the SELS Forecast Center, U. S. Weather Bureau; to George Byram of the Southeastern Forest Experiment Station, U. S. Forest Service; and in particular to J. H. Dieterich who accompanied him to the Dudley Lake Fire and assisted materially in the accumulation of the field data.

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Wanted: A Method of Rooting Yellow-Poplar Cuttings

In extensive tests at Oxford, Mississippi, auxins conspicuously failed to induce rooting of cuttings of yellow-poplar (*Liriodendron tulipifera*).

The auxins were indolebutyric acid, indoleacetic acid, and naphthaleneacetic acid, all applied in a variety of concentrations and immersion periods.

The cuttings were taken from one hundred saplings on the Tallahatchie Experimental Forest. They were made from the tips of lateral branches in the middle and upper crown, and represented 1-, 2-, and 3-year-old wood. Cuttings were made at two dates during the dormant season and five times during the growing season. After treatment they were planted in a well-watered sand-soil mixture on greenhouse benches, and kept under observation for 90 days.

Of 1,650 cuttings, only one rooted, and it was an untreated check. With this solitary exception, no difference could be noted between cuttings that had been soaked in solutions of auxins and those that had not.

Though details of the tests have been published elsewhere[1], the results are summarized here in the hope of stimulating further research. A feasible method of rooting yellow-poplar cuttings would be of considerable practical value. Current nursery production of seedlings is inadequate, chiefly because the seed is low in viability and difficult and expensive to collect.

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[1]Huckenpahler, B. J. Auxins fail to stimulate rooting of yellow-poplar cuttings. Bot. Gaz. 117:73-75. 1955.

Stem-Kill and Sprouting Following Prescribed Fires in a Pine-Hardwood Stand in Texas

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PRESCRIBED BURNING to control undesirable hardwoods has been reported for various forest types in the South and East (*1, 2, 3, 4*). In the loblolly-shortleaf type of the upper Coastal Plain, however, experience with prescribed fires has been quite limited. A study initiated in 1952 on the Austin Experimental Forest, near Nacogdoches, Texas, has developed information on the effect of fire on small hardwoods in this area.

Hardwoods under 1.5 inches in diameter were controlled much more readily than larger sizes. Tops were killed back more effectively by headfires than by backfires, and fires during the growing season were more effective than those at other times of the year.

Study Area

The study was made in an area supporting an immature loblolly-shortleaf sawlog stand and scattered overmature pines of the same species. Pine reproduction was sparse, but there was a fairly heavy understory of sapling and pole-size hardwoods.

The site had not been burned for at least 10 years. Litter depths varied from 0.2 to 1.3 inches; the deeper accumulations generally had a substantial proportion of pine needles. Grass and weeds were almost completely absent, as was other low vegetation. On the whole, the fuel was light but probably typical of this forest type in east Texas.

Experimental Procedure

There were 24 half-acre plots, providing three replicates of two fire intensities in four seasons. Within each half-acre plot a circular quarter-acre plot was located. The circular plot was subdivided into 10 equal wedge-shaped sectors. The objective was to locate within each sector five representative stems of each of four selected "indicator" species or species groups: sweetgum (*Liquidambar stryaciflua* L.), post oak and red oak (*Quercus stellata* var. *stellata* Wangenh, and *Q. falcata* var. *falcata* Michx.), loblolly pine (*Pinus taeda* L.), and shortleaf pine (*P. echinata* Mill.).

One stem of each species was sought in each of five stem-diameter classes (0.1-0.5, 0.6-1.5, 1.6-2.5, 2.6-3.5, and 3.6-4.5 inches, measured six inches above the groundline). To insure unbiased selection of sample stems, a separate starting point was randomly fixed for each sector and the required stems were located as closely as possible to the starting point. When a sector was deficient in any species-diameter class, the missing stem was located, if possible, in the nearest sector with a surplus. There were greater deficiencies in the final sample of large stems than in the sample of small stems.

Six plots were burned on each of the following dates: May 8, 1952; August 28, 1952; December 17, 1952; and March 6, 1953. On all of these days, temperature, wind, and humidity were suitable for prescribed burning (Table 1).

Headfires were set along the windward boundaries of the plots. The flanks were fired just in advance of the moving head to reduce the possibilities of a breakover, and finally the leeward boundaries were backfired to secure the headfire. As the headfires ran unchecked for less than 130 feet before meeting the backfires, they were somewhat analogous to strip headfires, where successive lines of fire are laid at right angles to the prevailing wind.

Backfires were set on the lee boundaries and generally were allowed to creep unassisted through the plots. It was sometimes necessary to set additional fires within the plots to keep the fire moving in a more or less straight line.

[1]East Texas Research Center, maintained in cooperation with Stephen F. Austin State College, Nacogdoches, Texas.

TABLE 1.—AVERAGE CONDITIONS DURING BURNS

Date of burn	Type of fire	Time of day	Days since last rain over 0.1 inch	Rel. hum.	Air temp.	Fuel moisture[1]	Wind		Av. flame height	Plot burning time
							Velocity	Direction		
			Number	*Pct.*	*Degrees F.*	*Percent*	*Mph.*		*Inches*	*Minutes*
5/8/52	Head	PM	9	33	86	5.5	2-3	SE	30-36	35
	Back	AM	9	52	81	7.0	1-2	SE	8-10	150
8/29/52	Head	PM	9	26	91	1.0	3-4	S	24-36	41
	Back	AM	9	52	79	10.0	1-2	S	6-10	210
12/17/52	Head	PM	13	64	66	5.5	3-4	SE-S	18-24	33
	Back	PM	13	64	66	5.5	3-4	SE-S	3-8	165
3/6/53	Head	PM	4	41	71	5.0	2	SE-SW	12-24	16
	Back	PM	4	41	71	5.0	2	SE-SW	8-18	126

[1]Estimated by use of fuel-moisture sticks located in a woods station.

In July and August of 1953, near the end of the first complete growing season following the burns, records were made of the condition of each stem, the number of sprouts, and the size of the dominant sprout. Similar information was obtained at the end of the second complete growing season, and most of the results reported here are from the second remeasurements.

Results

Stem-kill.—Stem kill[2] of each of the indicator species[3] was affected by fire intensity, season of burn, and size of stem. Headfires killed significantly more stems than did backfires (Fig. 1). Sweetgum was the most sensitive to both intensities of fire and pine was most resistant.

The percentage of stems killed in the four different seasons varied widely by species groups. The inventory two years after burning showed that August burns killed more stems of all species than December burns (Fig. 2). For pine, these were the only two seasons that differed significantly. For gum, December stem-skill was less than that for March or May at the 1-percent level of statistical significance. Differences between May and August were significant at the 5-percent level. Seasonal differences for oak were not significant.

Practically all hardwoods less than 0.6 inch in diameter were killed back to the rootstock (Fig. 3). For the 1-inch class the average stem-kill was 80 percent; for the 2-inch class, 45 percent; for the 3-inch class, 32 percent; and for the 4-inch class, 18 percent. In general, the fires temporarily controlled hardwood stems smaller than 1.5 inches; among larger stems, less than half were killed, though the reduction in numbers was still substantial.

Complete kill[4].—Season of burn did not significantly affect the percentage of oaks that were completely killed, but for sweetgum the complete kill from August fires was very significantly greater than that from December or March burns.

Headfires and backfires gave about equal results. This would suggest that the ability of a stem to sprout is probably a function of its physiological condition rather than the character of its injury.

Complete kill was also related to size of stem, but not so consistently as top-kill (Fig. 3). Although a smaller proportion of the larger size classes were killed back, the percent completely dead approaches that for the smaller, more easily damaged stems. At the end of the first growing season the apparent complete kill was only half as great as at the end of the second season.

Sprouting.—The success of a burn for hardwood control can be largely evaluated by the number and vigor of the sprouts that shoot up from rootstocks that have been damaged but not killed.

In this study the small stems, when killed back, produced fewer and smaller sprouts than the larger ones (Table 2). There were slightly but consistently fewer sprouts from stems killed by backfires than by headfires.

[2]Includes all stems where the original above-ground parts were killed, without regard to subsequent sprouting.

[3]Since there was little difference in the susceptibility of the two pine species, all pine data were combined.

[4]Refers to stems that showed no evidence of life above ground and that were devoid of sprouts.

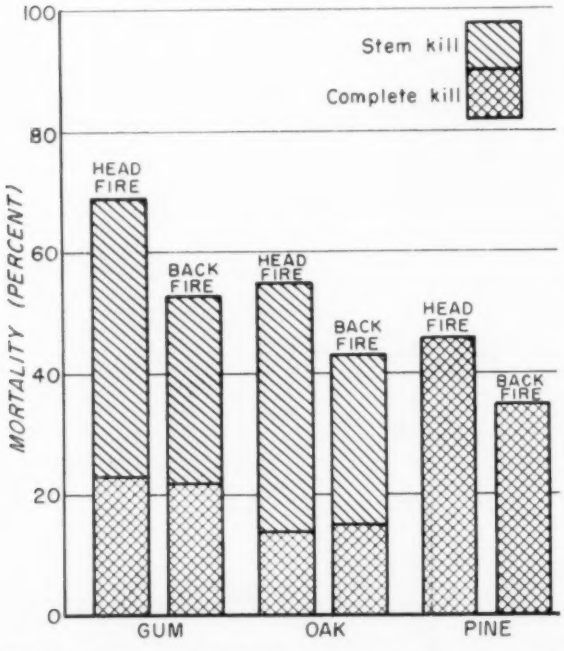

FIG. 1.—Average mortality of understory from headfires and backfires.

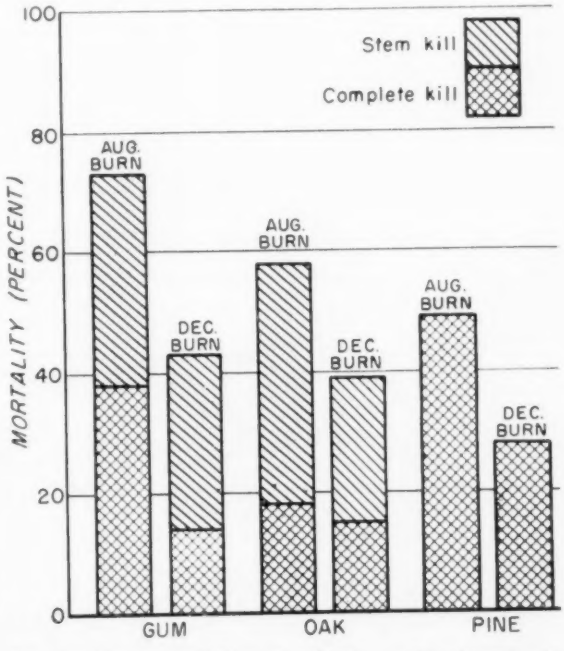

FIG. 2.—Average mortality of understory after August and December burns.

Although the percent of stem-kill was consistently lower for pine than for oak or gum, loblolly does not sprout and the sprouts of shortleaf are of questionable value. It is apparent from Figures 2 and 3 that the burns killed more pine rootstocks than hardwood.

As Table 2 indicates, the patterns of sprout development for oak and gum were quite similar, the chief difference being that the gum sprouts were larger than the oak sprouts.

Discussion

The ideal burn for hardwood control—one that kills a high percentage of hardwoods while damaging few pines—seems unattainable where trees of both groups are of equal size. In general, the fires that caused high mortality and damage in hardwoods also killed the most pines.

Seasonal differences in the effect of the fires on hardwoods were not large. Maximum effect was achieved by August burns, but fires in March and May, earlier in the growing season, also produced fairly satisfactory results. Thus there is a long growing season during which burns may be scheduled. This is fortunate, since it permits the forest manager to take full advantage of the relatively infrequent good burning days (neither too wet nor too dry).

Dormant-season burns should not be written off completely. The mid-winter fires did result in substantial stem-kill, and nearly as many trees were completely killed as by the growing-season fires. Hazardous fuel conditions or other practical considerations may sometimes make mid-winter burns preferable.

The best results were achieved by burning during the growing season with headfires, which in this test ran about 130 feet (Fig. 4). Stem-kill for these fires averaged 64 percent for oak and 78 percent for gum, while 14 and 23 percent respectively were completely eradicated. It seems clear that a follow-up fire would have dealt with the sprouts, the largest of which were not over 40 inches in height at the end of the second growing season.

Further study is planned to determine whether repeated burns, which in any case will be required to maintain control of the hardwood sprouts, will kill additional stems among the larger size classes.

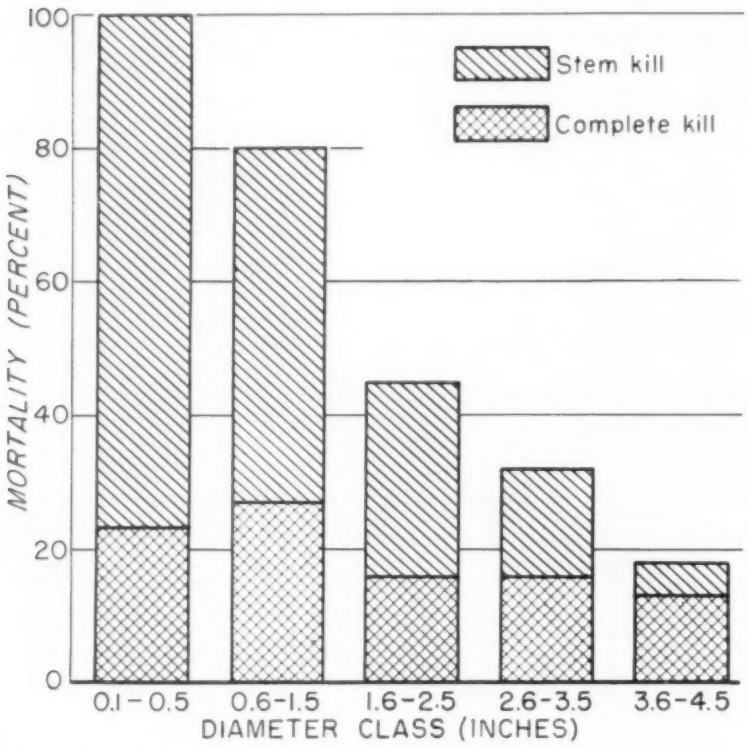

FIG. 3.—Average mortality of understory stems by diameter classes.

TABLE 2.—AVERAGE NUMBER, DIAMETER, AND HEIGHT OF SPROUTS PER SPROUTING STUMP, AS MEASURED AT THE END OF THE SECOND GROWING SEASON

Size (inches)	Species	Av. no. of sprouts per sprouting stump		Av. diam. of sprouts		Av. ht. of sprouts	
		Headfires	Backfires	Headfires	Backfires	Headfires	Backfires
		Number		*Inches*		*Inches*	
0.1-0.5	Oak	2.7	2.2	0.13	0.12	15	13
	Gum	2.2	2.0	.24	.20	29	27
0.6-1.5	Oak	4.2	3.4	.21	.20	22	22
	Gum	3.2	3.3	.30	.27	37	36
1.6-2.5	Oak	5.2	4.7	.26	.25	28	28
	Gum	5.3	5.3	.39	.33	46	46
2.6-3.5	Oak	5.9	4.8	.30	.25	28	25
	Gum	7.4	4.3	.43	.36	53	48
3.6-4.5	Oak	8.4	5.5	.36	.35	33	35
	Gum	7.5	.0	.43	.00	49	0

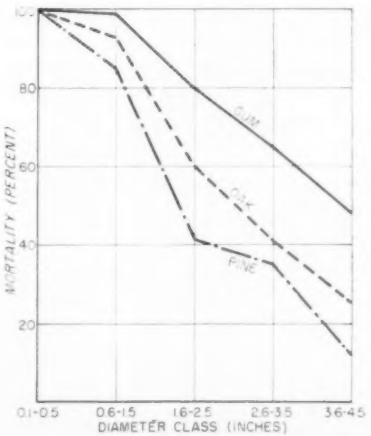

FIG. 4—Average mortality by species and size classes for headfires during the growing season.

Summary

Prescribed burns were made at four seasons of the year in an east Texas forest containing an immature loblolly pine overstory and a fairly heavy hardwood understory. Effects were observed on sweetgum, post and red oak, and pine stems under 4.5 inches in diameter.

Headfires killed back significantly more stems of all species than backfires, although complete kill of rootstocks of a relatively small number of hardwoods (10-20 percent) was achieved by all fires, regardless of intensity. While a smaller portion of the larger hardwood stems were killed back by fire, the percent of affected trees completely dead was much higher than for the smaller, more easily damaged stems.

Growing-season fires reduced the hardwood understory more than fires during the dormant season.

Temporary control of hardwood stems under 1.5 inches was achieved by single burns. For larger stems, control was still substantial, though less effective.

While proportionally more hardwood than pine stems were killed back, most of the injured pines were eradicated, while less than one-fourth of the hardwoods were completely killed. The number and size of sprouts from "dead" sprouting stems increases with increasing diameter of the original stems. Gum sprouts were almost one-third larger than comparable sprouts from the oaks, but after two years even the largest sprouts were still of a size to be easily controlled by fire.

Headfires during the growing season seemed to offer better possibilities for temporary control than headfires during the dormant season or backfires during any season. Further study is needed to determine if repeated burns will kill additional stems among the larger size classes.

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SCHOOL BOX SCORE
1957 MEMBERSHIP

School	Student applications received: June 1957	Total 1956	Total 1957
Alabama Polytechnic Institute	0	6	19
University of California	1	53	10
Colorado State University	1	28	14
Duke University	0	7	3
University of Florida	1	25	5
University of Georgia	1	30	56
University of Idaho	0	21	3
Iowa State College	0	31	14
Louisiana Polytechnic Institute	0	27	1
University of Idaho	0	21	3
Iowa State College	0	31	14
Louisiana Polytechnic Institute	0	27	1
Louisiana State University	7	22	19
University of Maine	0	13	11
University of Massachusetts	1	20	2
Michigan State University	0	50	9
University of Michigan	0	24	7
University of Minnesota	2	26	27
University of Missouri	1	2	36
Montana State University	4	17	43
State University of New York	0	38	23
North Carolina State College	0	24	1
Oregon State College	4	44	22
Pennsylvania State University	4	35	29
Purdue University	0	36	2
Utah State University	1	28	5
University of Washington	0	21	15
West Virginia University	0	5	19
Yale University	0	13	5
Totals	28	646	400

SECTION BOX SCORE
1957 MEMBERSHIP

Section	Applications received[1]: June 1957	Total 1956	Total 1957
Allegheny	6	58	60
Appalachian	3	58	15
Central Rocky Mountain	1	32	19
Central States	3	42	11
Columbia River	10	77	44
Gulf States	14	79	39
Inland Empire	0	32	3
Intermountain	1	35	5
Kentucky-Tennessee	1	12	5
New England	2	61	28
New York	0	45	32
Northern California	1	67	15
Northern Rocky Mountain	4	31	45
Ozark	5	19	51
Puget Sound	2	44	36
Southeastern	4	92	95
Southern California	0	2	2
Southwestern	1	2	2
Upper Mississippi Valley	3	72	45
Washington	0	1	10
Wisconsin-Michigan	1	102	27
Totals	62	963	589

[1]Students, Junior, Affiliate, Associate (Initial) grades only.

Mapping Soils for Pine Site Quality in South Arkansas and North Louisiana

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FORESTERS KNOW that, to get the best returns, they should concentrate their money and time on their better forest sites. But all too often they lack an adequate measure of site and thus cannot delineate accurately the good from the poor.

During the past two decades forest owners have gradually become aware of the need for site classification and today recognize it as necessary to intensive management (*7*). Soil-site research has kept pace with the demands of forest management in some parts of the country, and workable classification systems have been devised for many forest types in many geographic locations. Coile (*5*) has summarized most of the work done up to 1952, and much has been reported since (*1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19*).

Where suitable phytometers are absent, there has until recently been no practical method for classifying sites in the Coastal Plain pine forests of south Arkansas and north Louisiana. Turner's early work provided much accurate soil-site data for south Arkansas (*14*), but his findings were not readily applicable to field use. Recent studies, however, have furnished sufficient data for an effective system of assessing pine sites in this area (*20*).

This paper briefly summarizes the soil-site relationships for loblolly and shortleaf pine in south-central Arkansas and north-central Louisiana, and illustrates how these findings can be applied for mapping site quality on large areas of forest land.

Site Relationships

Site index (height of trees in feet at age 50 years) and soil and topographic data from 206 well-stocked 40- to 60-year-old stands of loblolly and shortleaf pine were subjected to rigorous statistical analysis (*20*). Results showed that site index is closely related to three site factors: (1) surface soil thickness or texture, (2) subsoil texture, and (3) slope.

Surface soil.—Those soils with well-developed horizons, that is, exhibiting a clearly distinguishable line between the surface soil and subsoil, were classified as "zonal." In such soils, the thickness of the surface soil can be readily measured from the ground surface down to the first major change in soil color and texture, or to the topmost subsoil layer (not necessarily to the least permeable horizon).

Site index was found to increase with increasing surface soil thickness to a maximum at about 18 inches. Deeper surface soils showed slightly decreased site quality.

Those soils with poor horizon development, where the surface layer grades gradually into the subsoil, were classified as "azonal." Site index here was correlated with surface soil texture, and was found to decrease with increasing amounts of silt in the surface 6 to 12 inches of soil.

Subsoil.—On both zonal and azonal soils, site index was found to increase as subsoil texture increased in fine material from sandy loams to clay loams. Friable clay loams had maximum site index. Further increases in fine material decreased the site index; thus, plastic clay and silty clay subsoils are poor sites.

Slope.—Zonal soils are characteristic of slopes and ridges in the rolling Coastal Plain uplands of the region studied. Site index decreased as slope percent increased, with gentler slopes providing the better sites and steep slopes (up to 15 percent) the poorer. Azonal soils are more limited to upland flatwoods and terraces, so that variations in slope are not great. Level areas with just adequate drainage (1 to 3 percent slope) were found to be better sites than either poorly drained flats (zero slope) or more rolling terraces (up to 5 percent slope).

Minor bottoms.—Small stream floodplains (with azonal soil profiles) were the best loblolly pine

TABLE 1.—SITE INDEX OF LOBLOLLY PINE ON ZONAL UPLAND SOILS

Textural grade of subsoil	Slope class	Thickness of surface soil				
		6 inches	12 inches	18 inches	24 inches	30 inches
	Percent	*Site index*				
Loam	1-5	74	81	84	82	75
(10-20 percent clay)	6-10	70	77	80	78	72
	11-15	67	74	76	74	68
Sandy clay loam	1-5	81	87	90	88	82
(20-30 percent clay)	6-10	77	84	86	84	78
	11-15	73	80	83	81	74
Clay loam	1-5	80	87	89	87	81
(30-40 percent clay)	6-10	76	83	86	84	77
	11-15	72	79	82	80	73
Light clay	1-5	76	83	85	83	77
(40-50 percent clay)	6-10	72	79	82	80	73
	11-15	68	75	78	76	69
Heavy clay	1-5	72	79	82	80	73
(Over 50 percent clay)	6-10	69	75	78	76	70
	11-15	65	72	74	72	66

sites in the area studied, having indices of 95 and better where internal drainage was good.

Site Index Tables

By correlating site index and the site factors summarized above, site index tables have been calculated for field use. Loblolly pine sites on zonal soils can be estimated from Table 1, loblolly pine on azonal soils from Table 2, and shortleaf pine on zonal soils from Table 3.[1]

Shortleaf pine is not a common associate of loblolly pine on azonal soils. Its site index on these soils may be estimated from that of loblolly pine by using the following relationship (*20*): Shortleaf site index = 13 + 0.77 (loblolly site index).

The values in the tables are based on classes of soil thickness and texture and percent of slope. Once the appropriate factors are determined for a site, it is easy to estimate site index. Those unfamiliar with the definition of soil textural grades can refer to the 1951 *Soil Survey Manual* (U. S. Dept. Agric. Agric. Handbk. 18, pp. 206-213). The additional distinction made in Tables 1 and 3 between light and heavy clay simply divides the clays into two groups, the latter composed of soils with more than 50 percent of clay. In all tables the textural classes are suggestive approximations, since site indices have been calculated from percent of clay or percent of silt plus clay.

Tables 1, 2, and 3 are for use only on upland Coastal Plain and terrace soils in the region studied. Small stream floodplains can be safely classed as site index 95 for loblolly pine. The site relationships are not valid on prairie soils, loess deposits, or major stream bottoms in this region.

Field Application

To illustrate how site classification may be applied in practice, an 800-acre forested area was mapped for pine site quality in Drew County, Arkansas. Field and office procedures for this task are outlined below.

The study area.—The area, part of the holdings of The Crossett Company, Crossett, Arkansas, lies in typical Coastal Plain physiography. Reconnaissance indicated that a wide variety of soil conditions would be found, and that differences in elevation of 30 feet or more would yield all topographic features common to Coastal Plain and terrace sites. Ridges, flats, and minor stream bottoms were represented. The timber types were loblolly-shortleaf pine on the uplands, and bottomland hardwoods-loblolly pine in the drainages. Much of the area was in young old-field pine plantations, and in cutover mature pine which was being regenerated.

Mapping.—The intensity of sampling depends, of course, on the desired accuracy of the finished map. For general management purposes on a large tract, an extensive survey is probably adequate—with no effort to delineate sites of less than 5 acres in extent.

A base map was prepared from aerial photographs. All section, quarter-section, and forty boundary lines were designated as cruise lines. Other cruise lines included the roads and trails which could be exactly located, as well as a gas pipeline right-of-way that ran diagonally across the area.

Coastal Plain soils are derived from parent materials that have generally been deposited in horizontal beds. This is true over relatively small areas, as within a square mile, for example. There may be slight tilting of these beds,

TABLE 2.—SITE INDEX OF LOBLOLLY PINE ON AZONAL UPLAND SOILS

Textural grade of subsoil	Slope class	Textural grade of surface soil: Sandy loam	Loam	Silt loam
	Percent	*Site index*		
Sandy loam to sandy clay loam (30-50 percent silt plus clay)	0	80	73	[1]
	2	87	79	
	4	81	74	
Loam to clay loam (50-70 percent silt plus clay)	0	90	85	
	2	96	91	
	4	91	86	
Clay (70-80 percent silt plus clay)	0	86	82	79
	2	92	89	85
	4	86	83	80
Silty clay loam to silty clay (Over 80 percent silt plus clay)	0		70	69
	2		77	75
	4		71	70

[1]The blank spaces indicate combinations of surface and subsoil textures which do not occur in nature.

TABLE 3.—SITE INDEX OF SHORTLEAF PINE ON ZONAL UPLAND SOILS

Textural grade of subsoil	Slope class	Thickness of surface soil: 6 inches	12 inches	18 inches	24 inches	30 inches
	Percent	*Site index*				
Loam (10-20 percent clay)	1-5	71	76	78	77	74
	6-10	64	69	71	70	66
	11-15	62	67	69	69	65
Sandy clay loam (20-30 percent clay)	1-5	75	80	82	81	77
	6-10	67	72	75	74	70
	11-15	66	71	73	72	68
Clay loam (30-40 percent clay)	1-5	76	81	83	82	78
	6-10	69	74	76	75	71
	11-15	67	72	74	74	70
Light clay (40-50 percent clay)	1-5	75	80	82	81	77
	6-10	67	73	75	74	70
	11-15	66	71	73	72	68
Heavy clay (Over 50 percent clay)	1-5	71	76	78	78	74
	6-10	64	69	71	70	66
	11-15	62	67	70	69	65

[1]The standard errors of estimate for the three regressions on which the tables are based are ± 4.5, ± 3.5, and ± 3.0 feet, respectively.

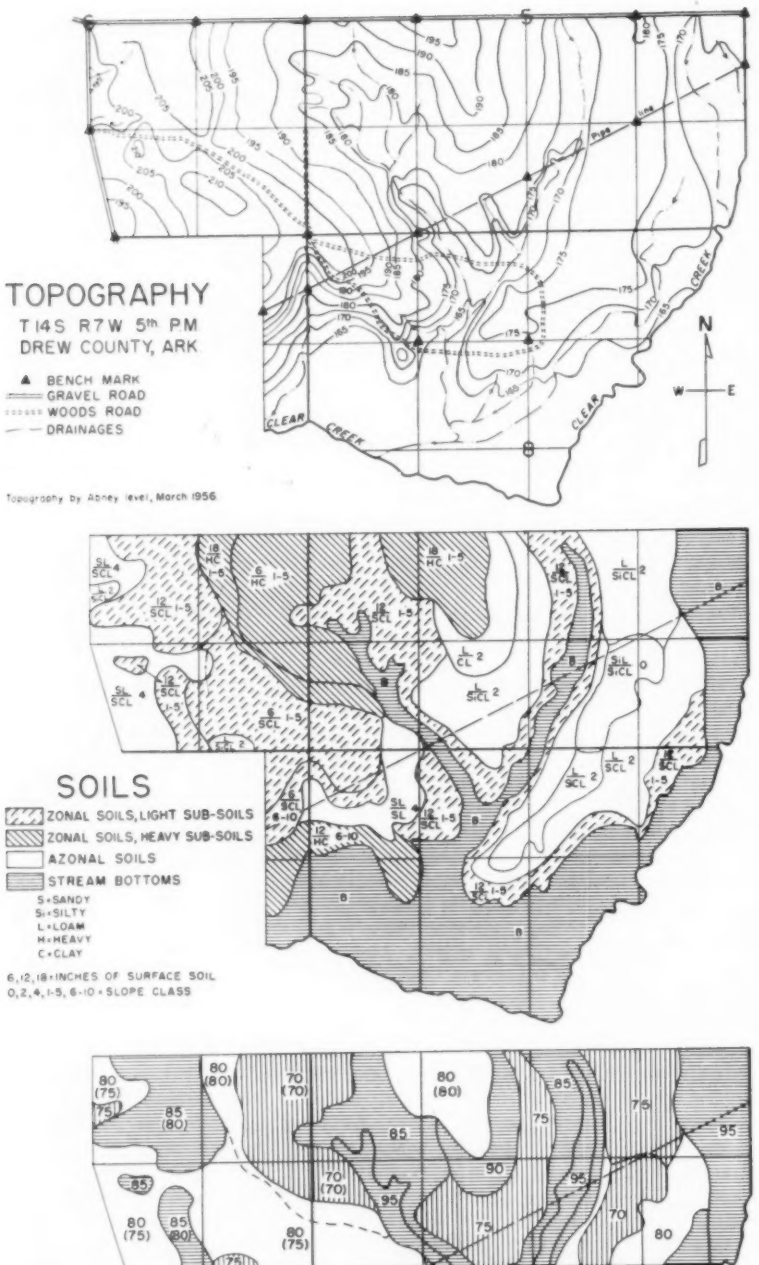

FIG. 1.—Maps of the study area.

but usually their outcroppings can be readily traced on contours. Thus, a topographic map is valuable in mapping soil distribution.

In this case, the soils were identified along cruise lines at the same time that elevation and topography were being mapped. Then the final soil delineations were correlated with the resulting topographic map.

For the topographic map, known elevations, or bench marks, were established at convenient locations with a spirit level. Abney hand levels were used to determine elevation changes along cruise lines, then 5-foot contours were sketched in, based on visual observations and aerial photographs. The resulting map (Fig. 1, top) was considered satisfactory for the purpose.[2]

Soils were first delineated along cruise lines. Pacing with a hand compass located more exactly the questionable soil transitions and delineations off the cruise lines. The final soils map (Fig. 1, middle) was then drawn by correlating field notes with topographic map.

Soils were identified with a soil auger. At each sampling point it was determined whether the profile was zonal or azonal. If zonal, the thickness of surface soil was recorded within a 6-inch class. If azonal, the texture of the surface soil was recorded. In addition, the texture of the subsoil was recorded for both zonal and azonal soils.

A coding system was used to facilitate the recording of data in the field. Surface soil characteristics were placed over subsoil characteristics, all followed by the slope class. Examples are as follows:

$\frac{12}{SCL}$ 1-5 means a zonal soil with 12 inches of surface soil overlying a subsoil of sandy clay loam with a general slope of 1 to 5 percent.

$\frac{SiL}{SiCL}$ 0 means an azonal soil

[2]Acknowledgement is extended to A. M. Smith of the Crossett Company for the topographic survey.

with silt loam surface soil over a subsoil of silty clay loam, with poor surface drainage (zero slope).

All recent stream deposits in drainages were classified as bottoms. Both surface and internal drainage were adequate in these bottomlands.

The coded soils information was transposed into classes of site index by means of Tables 1, 2, and 3. Bottomlands were assigned a site class of 95 for loblolly pine. Site indices were rounded off to the nearest 5 feet and recorded on a third map (Fig. 1, bottom). Shortleaf pine index was mapped only on the higher ridges, where the species occurs naturally.

The value of the site quality map is obvious. It will serve the forester with a guide to rotation age, stand treatment, and general intensity of management.

On the area studied, the forest manager intends to use the poor sites for even-aged pulpwood stands, possibly clearcutting and planting when the trees reach 30 years of age. Thinnings and improvement work will be kept to a minimum.

High-grade sawlogs will be the primary management objective on the good and intermediate sites. Intensive thinning, stand improvement, and other work will be concentrated on the good sites, but not neglected on the intermediate.

Discussion

With the sampling intensity used, it is not presumed that each 5-foot site interval is perfectly accurate. Although delineations of soil along survey lines are exact, further delineation probably does not correlate at all points with topography. Further, even if delineations of general conditions are mapped accurately, undetected local variations within the general conditions will certainly affect site index. Finally, the data from which the tables were derived were not perfectly correlated with the tabular estimates.

Notwithstanding these limitations, the mapping of this tract of forest land indicates how basic soil-site relationships can be applied to large areas. Actual field application is relatively simple and inexpensive.

A technically trained two-man crew completed the mapping in one 40-hour week, or at a cost of approximately 0.1 man-hour per acre. The map is certainly accurate enough to indicate good, medium, and poor sites.

If the forest manager recognizes and maps only poor conditions, he will have accomplished much. Often it is the poor site that does not support a ready measure of site index in the form of well-stocked pine, and is thus a dilemma to the forester. He is not certain that it is actually a poor site, and perhaps spends considerable effort attempting to put it into production. On the other hand, if the area is rightly mapped as a poor site, the forester may choose to concentrate more of his management expenditures elsewhere, on his better sites.

Summary and Conclusions

Recent soil-site studies have provided data for simple yet adequate site classification of loblolly and shortleaf pine forests in the Coastal Plain of south Arkansas and north Louisiana. Readily mapped site characteristics include surface soil thickness or surface soil texture, subsoil texture, and slope.

A sample site-quality map was made of an 800-acre pine tract for a cost of about 0.1 man-hour per acre. A topographic map supplemented a soils map, the latter then furnishing data for a site-quality map. The final map is valuable for forest management purposes.

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Decay Resistance of Western Redcedar

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THE HEARTWOOD OF western redcedar (*Thuja plicata* D. Don.) has always been highly regarded for its resistance to decay, and the species has been extensively used for shingles, poles, posts, boats, and other products that are subjected to conditions favorable to decay. In a recent comparative test of the decay resistance of certain western pole species grown in the Inland Empire (*5*), western redcedar proved generally superior, as was expected. It was observed, however, that this superiority was not exhibited in poles from all the tested trees. Moreover, where present, it tended to be limited largely to the lower half of the pole and especially to the outer portion of the heartwood.

It seemed desirable to learn whether this variation in decay resistance might also occur in other regions and whether it might be in any degree related to the size of the tree or its environmental surroundings. The testing of western redcedar was expanded, therefore, to include samples from a total of 67 trees growing on the principal pole- and shingle-producing areas, ranging from Montana to the Pacific Coast. In addition, 7 poles were sampled that had been in service 21 to 29 years. This old wood provided information about the permanence of the decay resistance.

Procedure

Sampling of trees. — Heartwood samples were taken from trees on seven general areas which ranged in location from near the Pacific Coast to approximately 500 miles inland. Elevations of these areas ranged from about 1,500 feet to 5,400 feet. The samples were collected in the form of cross sectional disks, flitches from shingle bolts, or shakes. Except for the shakes the material came from comparatively recently felled trees. It was impractical to obtain wood representing large virgin timber other than from shakes out of logs that had been on the ground for an indefinite time. Whatever the age of this wood from dead timber, however, it was of normal color and appeared to be altogether sound. More than half the trees were of pole size. And insofar as could be determined, most of the samples came from the lower trunk. The shake samples were all out of large cross sections from indefinite heights in the trunk. A limited number of samples were taken at three different depths in the heartwood for information about radial differences in decay resistance. The remainder were all from the outer third of the heartwood radius. The various known sampling variables are shown with the presentation of results.

Method of testing decay resistance.—The decay tests were made by what is generally known as the soil-block technique, which is a laboratory procedure employing pure cultures of decay fungi. The testing chambers consisted of 6-ounce, screw-topped, French-square bottles, each half filled with loam soil that had a pH of 5.6. Sufficient water was added to the soil to bring its moisture content to 42 to 45 percent. A feeder block of southern pine sapwood, 1 by 1 by ⅛ inch in size, was placed on the soil in each bottle, and the bottle and contents were sterilized by autoclaving. After the bottles had cooled, the feeder blocks were inoculated with one of the test fungi, which had been grown on malt-agar in Petri dishes. Three weeks later, the test specimens, in the form of 1- by 1- by ⅜-inch blocks, were placed, one to a bottle, on the feeder blocks, which by that time had been overgrown by the fungi. The specimens previously had been partially sterilized by autoclaving in closed containers for 20 minutes at 212° F. The bottles were then incubated for 3 months in a room maintained at a temperature of 80° F. and a relative humidity of 70 percent.

At the end of the incubation period, the specimens were removed, wiped free of surface fungus growth, and dried to constant weight in a conditioning room, which was maintained at a constant temperature and relative humidity. The percentage difference between the weight of a specimen at this time and its weight in the same conditioning room prior to testing was the measure of the amount of decay that had occurred.

The test fungi were *Poria incrassata* (Madison 563), *Poria monticola* (Madison 698), *Leazites trabea* (Madison 617), *Fomes subroseus* (Madison 701), and *Lentinus lepideus* (Madison 534). All of these fungi are prominent causes of decay in coniferous wood, and all have been used in other tests.

Test Results

The weight losses produced by decay in the test blocks, the general locations of the source trees, and the diameters and growth rates in the sampled portions are listed in Table 1. The greater the weight loss, the more extensive the decay, and therefore, the smaller the decay resistance exhibited. To put the comparisons on as uniform a basis

[1]Maintained in cooperation with the University of Wisconsin.

TABLE 1.—DECAY RESISTANCE EXHIBITED BY WESTERN REDCEDAR SAMPLES FROM THE OUTER HEARTWOOD OF TREES OF VARIOUS SIZES AND SOURCES[1]

General location of sampled trees, and material sampled				Heartwood diameter where sampled[3]	Rings per inch in test blocks	Weight loss[2] produced by test fungi in block samples				
Place and material	Approximate distance of trees inland	Estimate elevation of trees	Tree no.			*Poria incrassata*	*Poria monticola*	*Lenzites trabea*	*Fomes subroseus*	*Lentinus lepideus*
	Miles	*Ft.*		*In.*		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Pacific Northwest, British Columbia, North Vancouver Island (Pole stock)	Nominally coastal	Unknown	16	12	57	45	28	2	8	10
			17	12	20	27	3	1	2	2
Washington Olympic Peninsula, (No. of localities indefinite) (Shingle bolts)	Nominally coastal	2,000-2,500	42	31	22	1	2	2	1	2
			43	Largely 18-30	23	2	2	2	2	2
			44	Do	38	17	3	1	2	2
			45	Do	17	2	4	1	1	1
			46	Do	59	1	3	2	2	2
			47	Do.	21	4	3	3	4	2
			48	Do	15	2	2	2	1	2
			49	Do	28	2	2	4	2	3
			50	Do	34	4	6	5	2	4
			51	Do	27	3	1	1	1	2
			52	Do	29	1	3	3	3	3
			53	Do	18	3	2	1	1	1
			54	Do	46	3	3	3	3	8
			55	Do	86	3	3	5	2	6
			56	Do	38	3	4	4	3	3
			57	Do	50	27	12	3	3	3
			[5]58	Do	22	5	4	4	2	4
Washington West Slope Foothills Near Mount St. Helens (No. of localities indefinite) (Shingle bolts)	80	1,500-2,500	59	30	28	4	2	3	2	3
			60	34	30	6	9	4	4	4
			61	24	19	36	37	3	8	4
			62	31	32	2	4	2	1	2
			63	32	32	28	17	3	6	3
			64	28	41	16	2	3	1	2
			65	18	17	32	44	16	13	6
			66	35	22	31	30	2	2	2
Washington Western Foothills near Mount Rainier (One locality represented) (Shakes from dead timber)	100	1,500-2,500	67	Largely 48-96	14	12	10	4	3	3
			68	Do	17	26	16	2	2	2
			69	Do	30	2	3	3	3	2
			70	Do	20	23	14	2	2	2
			71	Do	9	6	5	4	3	3
			72	Do	11	18	21	4	4	3
			73	Do	9	24	31	2	3	3
			74	Do	12	11	14	3	3	2
British Columbia, Northwest part, vicinity of Babine Mountains (One locality represented) (Pole stock)	140	2,000-3,000	8	14	25	35	19	1	4	4
			9	12	38	26	1	1	1	3
			10	12	13	8	2	1	1	2
			11	9	42	27	24	2	2	8
Northwest Interior British Columbia, Southeastern part, vicinity of Monashee and Selkirk Mountains (Four localities represented) (Pole stock)	400-450	2,000-3,000	12	10	44	40	18	1	1	3
			13	12	34	34	2	2	1	3
			14	12	14	27	1	1	3	2
			15	8	26	44	13	1	6	5
			18	13	12	18	2	1	1	2
			19	12	15	39	7	1	2	4
			20	12	16	39	12	2	1	2
			21	12	23	28	2	1	1	2
			22	13	49	28	17	2	2	2
			23			34	22	1	0.6	3
			24	13		29	24	1	1	6
			25	12		42	38	1	5	21
			26			46	42	12	6	20
Washington, Idaho, Montana, Inland Empire Region (Three localities represented) (Pole Stock)	400-500	2,800-4,000	27	12	14	33	2	2	4	1
		Do	28	9	16	49	41	15	15	22
		Do	29	8	18	32	19	9	11	13
		Do	30	7	21	40	22	3	4	4
		Do	31	10	23	24	1	1	1	1
		2,900-5,400	32	10	24	22	5	1	1	1
		Do	33	14	35	28	9	1	1	1
		Do	34	7	17	35	20	12	12	16
		Do	35	10	13	28	9	1	1	1
		Do	36	12	33	19	6	1	1	1
		3,400	37	10	26	34	5	5	2	4
		Do	38	7	38	32	8	1	2	1
		Do	39	11	29	32	23	8	5	12
		Do	40	14	16	18	1	1	1	1
		Do	41	12	18	24	6	1	0	1

[1]Samples were from the lower trunk in most instances, except probably for some of those from the shake bolts.
[2]Figures are averages of tests in duplicate.
[3]Diameters for the Inland Empire group of trees include the sapwood thickness.

as possible, the samples characterized by the data of Table 1 were, in most instances, from the outer heartwood and the lower portion of the trunk.

In considering the results, it should be kept in mind that, unless otherwise stated, the data and discussion pertain strictly to heartwood. The sapwood of western redcedar, like that of all other woods, has a low order of decay resistance.

Variation among trees in heartwood decay resistance.—With comparatively few exceptions, there were no significant differences among the trees in resistance of the wood to *Lenzites trabea*, *Fomes subroseus*, or *Lentinus lepideus*. A uniformly high level of resistance was exhibited in nearly all cases. These observations serve mainly to indicate what is generally recognized, that western redcedar has a broad base of resistance to many fungi that are capable of destroying a variety of other woods.

On the other hand, there were large differences among trees in resistance to *Poria incrassata* and to *Poria monticola*. These two fungi typically attack wood more severely than most wood-destroying species. Consequently, although these fungi would not necessarily be the ones that would attack the wood in service, they presumably bring out representative differences in resistance to a variety of the more potent wood-destroying species, especially in comparatively severe types of service exposure such as contact with damp ground. Since much of the interest in the decay resistance of western redcedar pertains to its serviceability when placed in the ground, the Poria results are stressed here in considering variations in resistance and associated factors. Moreover, particular attention is paid to *P. monticola* for some of the comparisons because it is the most prevalent of the two fungi in causing decay of wood in service.

There was no indication that the variation among trees in decay resistance of the heartwood was related to the elevation of the growing site or to the rate at which the wood was grown (rings per inch). There was a definite association, however, between the heartwood diameter of the tree and the indicated resistance to decay by *P. incrassata*, but not by *P. monticola* (Fig. 1). The average weight loss produced by *P. incrassata* was 31 percent in outer heartwood from trunk sections smaller than 20 inches in heartwood diameter, and only 11 percent in wood from the larger sections. This marked tendency for the decay resistance of the outer heartwood to increase with increasing diameter of the tree has been observed in black locust *(12)* and in white oak *(11)*, and it is probably rather common among timber species that have better than moderate decay resistance.

Figure 1 also indicates that there were no important regional differ-

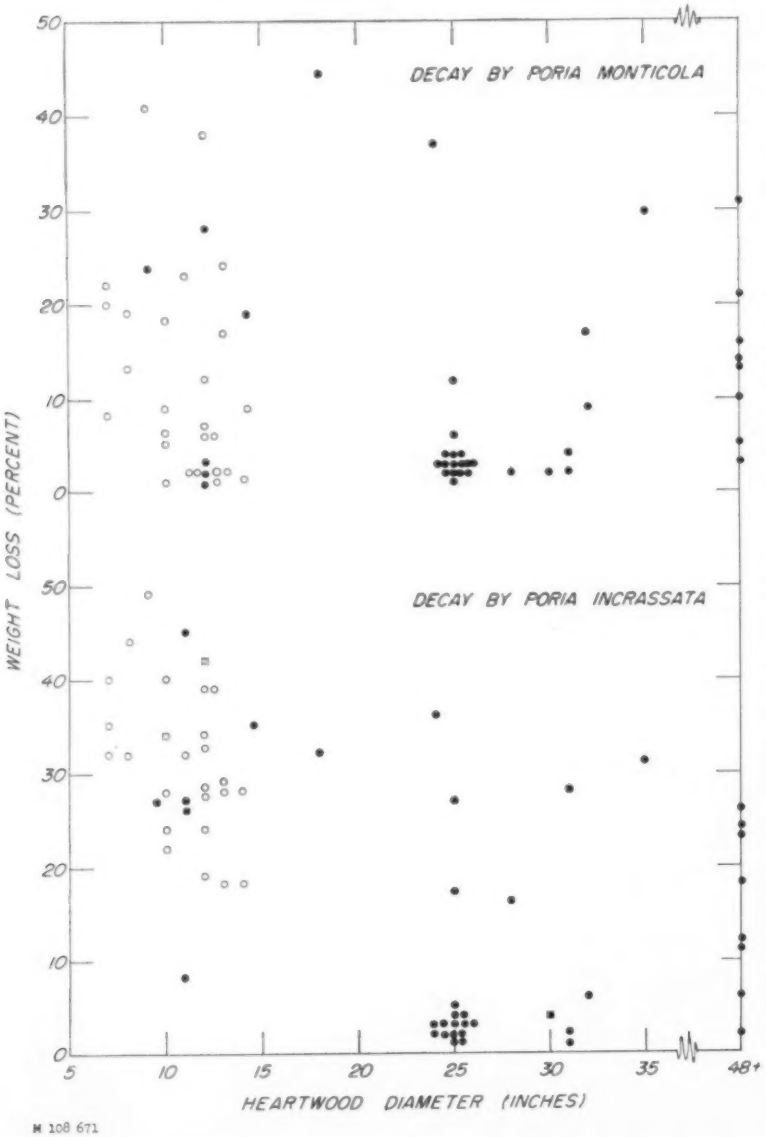

FIG. 1.—Weight losses produced by the Poria test fungi in specimens of outer heartwood from trees with various heartwood diameters at the point of sampling. Diameters for the Inland Empire trees (see Table 1) include the sapwood thickness. Closed circles represent trees grown in the Pacific Northwest; open circles represent trees grown in the Northwest Interior.

ences in the decay resistance of the wood. Although the decay caused by *P. incrassata* in specimens from trees grown 400 to 500 miles inland was considerably greater than that in specimens from Pacific Northwest trees, the differences obviously arose from the difference in the diameters of the sampled trees. The exceptionally large proportion of trees from the Olympic Peninsula that had very resistant wood indicates that there may be some localities where decay resistance of the wood is markedly superior to that of most other localities (Table 1 and Fig. 1). Such a situation has been found in species of the white oak group *(12)* but of more frequent occurrence than is indicated for the redcedar.

Some of the variation among trees in resistance of the wood to Poria is undoubtedly attributable to inherent or genetic differences in the fungus-resisting composition of the wood. The magnitude of this variation can be appraised by observing the differences in decay resistance among trees within restricted heartwood-diameter groups. This can be done with the aid of Table 2. Although a large proportion of the trees of roughly comparable size had outer heartwood with the superior decay resistance (resistant or very resistant) for which the species is noted, 9 to 17 percent of them were only moderately resistant to *P. monticola*. Moreover, in the case of the smaller diameters of heartwood as many as 80 percent of the trees exhibited moderate or lower resistance to *P. incrassata*. This figure is extreme, of course, but it indicates what may occasionally be encountered in practice with a combination of wood from the smaller trees and certain fungi particularly capable of attacking western redcedar. The values of 9 to 17 percent probably indicate more nearly the proportion of trees that might generally be expected to provide only moderate resistance to decay under conditions of ground-contact service.

Systematic variation in decay resistance within individual trees.—The decay resistance varied not only among trees but also within individual trees. Moreover, this variation tended to have a fairly well defined pattern. A similar situation has previously been observed in western redcedar *(2)* and other woods *(3, 10, 11, 12, 13)*.

A prominent feature of this within-tree variation was a radial retrogression of resistance from the outer heartwood to the inner heartwood. This is brought out in Figure 2, in which the radial trends of weight loss are shown for 23 trees, which were grouped according to diameter of heartwood and amount of decay in the outer heartwood. Data for the inner heartwood are missing in the larger diameter classes because this position was not present in the shingle and shake bolts that comprised these classes.

TABLE 2.—INDICATED PROPORTIONS OF THE SAMPLED WESTERN REDCEDAR TREES WITH OUTER HEARTWOOD IN VARIOUS CLASSES OF RESISTANCE TO THE DIFFERENT TEST FUNGI[1]

Decay fungus	Heartwood diameter of sampled trunk section	Proportion of trees in various resistance classes			
		Very resistant	Resistant	Moderately resistant	Relatively non-resistant
	Inches	*Percent*	*Percent*	*Percent*	*Percent*
Poria monticola	7 to 18	52	31	17	0
	24 to 48+	72	19	9	0
Poria incrassata	7 to 18	3	17	71	9
	24 to 48+	62	22	16	0
M617, M701, M534[2]	7 to 18	81	19	0	0
	24 to 48	100	0	0	0

[1]The decay classes are based on weight losses and the relation observed in previous similar tests between weight losse s and the generally accepted reputations for decay resistance of certain woods. The classification is made as follows: weight loss 0 to 10 percent, very resistant; 11 to 24 percent, resistant; 25 to44percent,moderately resistant; and 45 percent or more, nonresistant.

[2]Values represent the most severe attack by ane of the three fungi: *Lenzites trabea* (Madison 617), *Fomes subroseus* (Madison 701), or *Lentinus lepideus* (Madison 534).

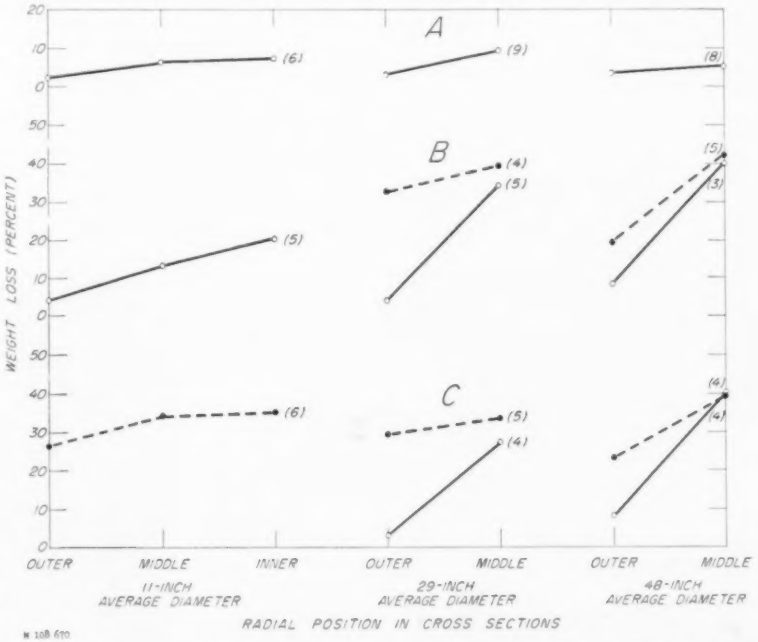

FIG. 2.—Variation in decay of test specimens from different radial positions in basal heartwood cross sections: (*A*), Average of decay by *Lenzites trabea, Fomes subroseus,* and *Lentinus lepideus;* (*B*), Decay by *Poria monticola;* and (*C*), Decay by *Poria incrassata.* Cross sections in which the outer heartwood incurred more than a 12 percent loss in weight are represented by broken lines, and the remainder by solid lines. The number of trees represented in each case is shown by the figure opposite the curve.

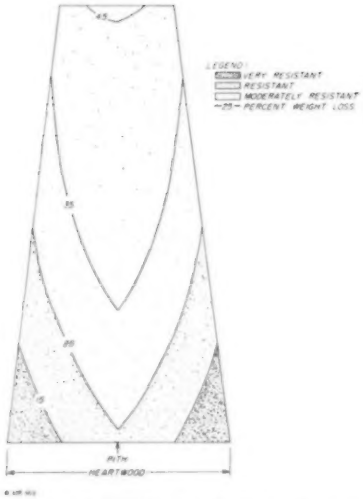

FIG. 3.—Composite longitudinal diagram of the heartwood of 6 trees showing the indicated distribution of resistance to decay by *Poria monticola*, one of the two test fungi that was most able to attack western redcedar wood. The lines are contours of percentage weight loss in test samples, with values indicated by the associated figures. The sampled trees were of average pole class 4-40, with mean d.i.b. at groundline of about 13 inches and height of 40 feet.

The average weight loss in all groups represented and for decay by all fungi was greater in the middle than in the outer heartwood and greater in the inner than in the middle heartwood. The indicated decay resistance, of course, would be just the reverse. These radial differences generally were considerably smaller in the trees with only moderately resistant outer heartwood (represented by the broken lines in Fig. 2) than in the trees of the same diameter class with resistant outer heartwood. This is attributable to the fact that in trees of comparable size the decay resistance of the middle heartwood tended to be similar, irrespective of the level of resistance of the outer heartwood. The larger radial differences in resistance to *P. monticola* also tended to be greater in the 29-inch and bigger than in the smaller trees. Therefore, the largest radial differences in the decay resistance of western redcedar apparently occur in trees in which large diameter and resistant outer heartwood are combined.

In addition to radial trends, longitudinal or vertical trends in decay resistance were looked for in six pole-size trees. Two results of special interest were obtained: the decay resistance of wood at a given radial position decreased from the base to the upper trunk, and the differences in resistance between outer and inner heartwood were progressively smaller with the increasing height in the trunk. These observations suggest that the decay resistance may be related to heartwood diameter within individual trees in the same manner as it is among different trees. The relationship is more uniform within trees, however, because of the absence of any complicating genetic differences. A composite portrayal of both the longitudinal and radial pattern of resistance to decay by *P. monticola* in the six trees is given in Figure 3. The weight loss indicated for the outer basal heartwood of the figure is close to the average (13 percent) for *P. monticola* decay in wood of all 33 of the trees with heartwood in the diameter range of 7 to 18 inches. Consequently, the figure is believed to represent what might be expected commonly in trees of this size.

Irregular variation in decay resistance within trees.—The curves of Figure 2 and 3 give a picture of rather orderly variation in decay resistance within trees. However, the variation may not always be orderly because of local deviations from the overall pattern. A notable example of such irregular distribution of decay resistance is caused by so-called internal sapwood. Internal sapwood is found in western redcedar and certain associated woods, such as Douglas-fir and western larch, where it typically occurs in concentric rings (Fig. 4). It consists of wood that never matured sufficiently, possibly because of frost injury *(4)*, to be infiltrated by the materials that give the heartwood its characteristic darker color and decay resistance. In tests of internal sapwood from two redcedar trees, the decay resistance was found to be as low as that of the regular sapwood. Thus, internal sapwood presents zones highly susceptible to decay encased within the heartwood.

Variability in decay resistance

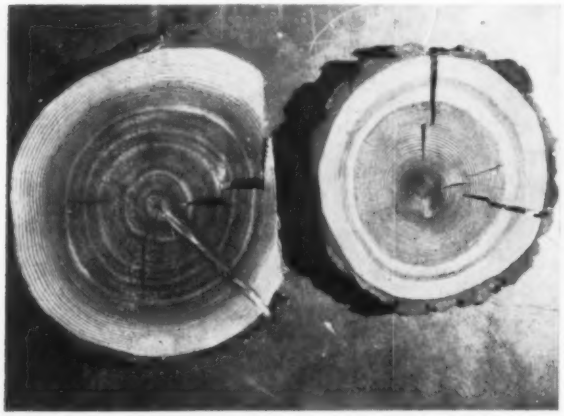

FIG. 4.—Basal sections from western redcedar (left) and western larch trees showing bands of so-called internal sapwood.

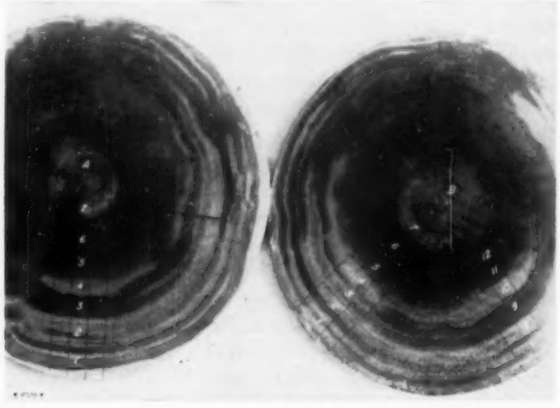

FIG. 5.—Tested cross sections of trees containing dark brown heartwood associated at a distance in the trunk with heart rot. Points at which specimens were removed for testing are numbered, and correspondingly numbered results of the tests are given in Table 3.

was also observed in sampling across light to medium brown and dark brown heartwood. The dark brown wood as viewed on a cross section was often distributed in irregular circular or semi-circular bands, alternating with the lighter colored wood (Fig. 5). Frequently it occupied much of the central area. This dark wood is rather common in the larger, older timber of at least the Pacific Northwest Coastal stands. The color does not appear to be natural; it seems instead to be regularly associated with heart rot at some other position in the trunk. It may be the same as the "spires of coloration from decay area" mentioned by Eades and Alexander, and the associated decay probably was one or more of the kinds described by Buckland *(1)*. Two sections containing this dark wood were studied for decay resistance (Fig. 5). Weight losses in samples from the dark brown wood and from associated tan and neutral brown wood are given in Table 3. Although there were inconsistencies, the dark brown wood generally incurred considerably larger amounts of decay by the Poria fungi than the tan wood; and the differences between adjacent light and dark samples seemed greater than might be accounted for simply by differences in the radial positions of the samples. The lesser decay resistance of the dark brown wood was not as apparent for the three other fungi.

Aside from the associations with internal sapwood and with dark heartwood, there was little indication of a further relation of decay resistance to wood color.

A third kind of irregular variability in resistance was unrelated to any visible character of the wood that could furnish a basis for predicting it. It was manifested in uneven decay of many of the test blocks (Fig. 6), as though the natural preservatives were not uniformly distributed in some of the wood. The same type of unsystematic distribution of decay resistance probably exists in many species.

TABLE 3.—INDICATED DECAY RESISTANCE OF WOOD FROM THE DARK BROWN AND LIGHT COLORED ZONES IN CROSS SECTIONS ILLUSTRATED IN FIGURE 5

Section and radial position as shown on Figure 5	Color of wood	Weight loss[1] caused by: *Poria incrassata*	*Poria monticola*	*Lenzites trabea*	*Fomes subroseus*	*Lentinus lepideus*
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
A-1	Tan	1	10	1	1	1
A-2	Tan	1	21	2	3	1
A-3	Dark brown	33	32	2	2	7
A-4	Tan	11	17	41	2	2
A-5	Dark brown	36	42	5	12	6
A-6	Dark brown	35	48	26	11	4
A-7	Brown	38	46	26	24	1
B-1	Tan	8	3	2	1	1
B-2	Tan	1	5	1	2	2
B-3	Tan	2	7	2	1	1
B-4	Tan	21	5	1	1	1
B-5	Brown	33	44	16	2	2
B-6	Dark brown	34	42	7	2	2
B-7	Brown	46	57	39	16	28
B-8	Tan	1	7	2	1	1
B-9	Dark brown	40	34	1	1	1
B-10	Tan	10	19	1	1	1
B-11	Dark brown	33	40	1	4	2
B-12	Dark brown	34	35	3	7	1

[1]Each value represents samples tested in duplicate.

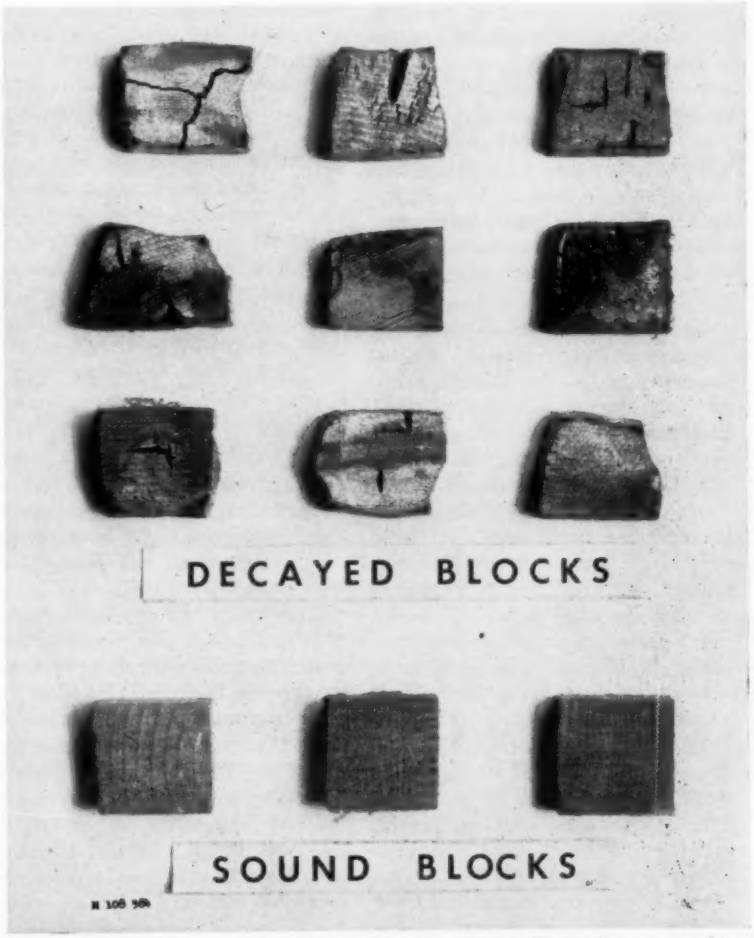

FIG. 6—Representative sound and decayed test specimens, illustrating uneven decay which indicates pronounced local unevenness of distribution of natural preservatives in the wood.

Selection of Western Redcedar for Decay Resistance

Inasmuch as differences in the decay resistance of western redcedar heartwood apparently are but little related to geographic location or environmental features of the growing site, the factors of tree size, position of the wood in the tree, and, to a limited extent, the coloring of the wood are the only ones dealt with in this study that might serve as criteria for selecting wood of maximum decay resistance.

Internal sapwood and large amounts of very dark heartwood would make an inferior shingle, which might warrant limited usage for the purpose. Otherwise, attempts to select wood for this and similar above-ground uses for the purpose of avoiding decay would seem to be neither practicable nor necessary. The hazard of decay in redcedar in such kinds of service is generally no more than moderate, and experience has shown that unselected stock so used will provide long service. It may be of some significance that decay fungi like the Porias, which were outstandingly able to attack the wood, seem to be considerably less prevalent than other fungi in wood used above ground.

There likewise would not be much point in trying to select poles for decay resistance. Requirements for pole classes based on physical demands would invariably preclude any choice of diameters for decay control. Moreover, inasmuch as the sapwood of poles is protected by preservative treatment, at least near and below the groundline, the highest level of decay resistance may not be needed for the heartwood. Internal sapwood in a pole might be objectionable if it were close enough to the heartwood boundary to be reached by seasoning checks. Fortunately, however, the outermost ring of internal sapwood in western redcedar seems generally to be an inch or more inside the heartwood. Therefore, it is rather well protected from exposure. As circumstantial evidence of this, internal sapwood is rather prevalent in trees from the Northwest Interior; yet this region has been a leading source of durable western redcedar poles. Internal sapwood apparently is rarely present in Pacific Northwest western redcedar trees, at least in those grown west of the Cascade Mountains.

An opportunity for advantageous selection of redcedar wood for maximum durability might be found in procuring fence posts. From the test results it is reasonable to expect that the most durable posts would be those split from the outer heartwood in the lower trunk of large trees. The least durable, on the average, would be round posts from small trees or from the upper trunks of larger trees and split posts from the central heartwood of large trees. Just what the differences in serviceability might be cannot be said, but indications from the data on the Poria test fungi are that they might be rather large. As a guide to what might be expected, weight losses shown in the tables and figures for decay by *P. monticola* of less than 25 percent are here considered to be indicative of resistant or very resistant wood. Correspondingly, losses of 25 to 44 percent are regarded as evidence of moderately resistant wood. Judged on the same basis, Douglas-fir and western larch heartwood would be classed as moderately resistant on the average.

Permanence of Decay Resistance in Western Redcedar

The natural preservative responsible for at least a large share of the decay resistance of western redcedar heartwood is *thujaplicin*, which has phenol-like properties and exists in three isomeric forms *(6, 8)*. Another less powerful fungus-inhibiting component of the wood is a polyphenolic fraction *(9)*. Both materials can be extracted from the wood with hot water *(14, 7)*. Their solubility in cold water is sufficiently great to impart marked toxicity to the water *(14, 8)*. Loss of the materials through leaching probably is mainly responsible for much of the gradual lowering of decay resistance in exposed parts of western redcedar shingles. A striking example of reduced decay resistance brought about by leaching was found in a recent stake test of a group of western woods *(5)*. On a site in Mississippi where the soil was kept comparatively wet by frequent rain, cedar heartwood stakes suffered more decay than those of normally less durable woods. The influence of leaching was indicated by a peculiar distribution of the decay; the outermost part of the stakes below ground typically was uniformly and heavily decayed whereas the wood beneath this shell of decay was comparatively sound. Decay induced by leaching in a larger specimen of cedar, such as a post, probably would be similar to that just described but relatively less damaging.

Serious leaching of the heartwood of treated poles or round posts is unlikely because of the protection afforded by the layer of preserved sapwood. In any case, the matter of leaching is brought up here not to indicate specifically what its practical effect may be but to point out that the effect may be sizeable in certain situations.

The sampling of the poles that had been in service 21 to 29 years presented an excellent opportunity for noting possible changes in decay resistance of the heartwood. Seven such poles were sampled at the groundline and about 6 feet above the groundline, and tests were made of the heartwood in exactly the same manner as described for the other wood. There was no visible decay in any of the heartwood. The groundline portion of all the poles and the upper portion of two of them had been heavily creosoted. The test results were not influenced by the creosote treatment, however, as it extended no deeper than the sapwood.

Table 4 provides a comparison of test weight losses in the wood from old poles and from freshly cut wood. The average weight losses in the outer heartwood of specimens of fresh wood decayed by *P. incrassata* and *P. monticola* were, respectively, 31 and 14 percent. Corresponding losses in specimens from the groundline section of old poles were 35 and 30 percent. Only

a comparatively slight loss in resistance to *P. incrassata* is apparent, but the wood dropped from the resistant to the moderately resistant class with respect to decay by *P. monticola*. Perhaps the most striking evidence of change is the lowering of resistance to *Lenzites trabea*, *Fomes subroseus*, and *Lentinus lepideus*. The average weight losses caused by these fungi in outer heartwood specimens from the 31 trees was 3 to 5 percent, whereas corresponding losses for the poles were 14 to 20 percent. With respect to these fungi, therefore, the shift was from a very resistant to a resistant class wood. Consideration of the data for the above-ground part of the poles gives practically the same comparisons. It appeared, therefore, that aging of the poles for 21 to 29 years resulted in a drop of one class of resistance to all but one of the test fungi.

The nature of the change responsible for the lowered decay resistance of the pole heartwood is uncertain. Inasmuch as the resistance of the groundline and of the higher portions of the poles was practically the same, it seems unlikely that leaching could have been a factor. Moreover, the radial differences in resistance were still about as large as in the fresh wood (Fig. 1), which would hardly be expected if the outer heartwood were affected most, as would necessarily be the case with leaching. The same reasoning would apply to loss of natural preservatives by volatilization. The only other possibility is that the preservatives slowly undergo chemical modification that renders them less potent. Conceivably the same type of change with aging of the wood that helps make the radial trends of resistance within the standing trees continues after the wood is placed in use.

TABLE 4.—WEIGHT LOSSES PRODUCED BY DECAY IN SAMPLES FROM SEVEN WESTERN REDCEDAR POLES THAT HAD BEEN IN SERVICE 21 TO 29 YEARS[1] COMPARED WITH LOSSES FROM RECENT FELLED TREES

Test fungus	Average weight loss[2] in wood from indicated parts of poles						Average weight loss in wood from 35 recently felled trees of pole size (from data of Table 1)
	Groundline portion			Above-ground portion			
	Outer heartwood	Middle heartwood	Inner heartwood	Outer heartwood	Middle heartwood	Inner heartwood	Outer heartwood
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Poria incrassata	35	38	34	35	37	42	31
Poria monticola	30	42	49	32	40	50	14
Lenzites trabea	14	17	23	10	18	24	3
Fomes subroseus	19	34	46	16	34	50	3
Lctinus lepideus	20	28	34	20	27	36	5
Average	24	32	37	23	31	40	

[1]Years of service for the 7 poles were 21, 23 (3 poles), 27, and 29 (2 poles). Average heartwood diameters of the sections tested were: groundline section—11.6 inches; above ground section—10.6 inches.
[2]The test by a given fungus of each position in a tree was made in duplicate.

Summary

Laboratory decay tests were made of heartwood specimens from 67 trees grown at different elevations and on areas from the Pacific Coast to points approximately 500 miles inland. The level of resistance to decay by *Lenzites trabea*, *Fomes subroseus*, and *Lentinus lepideus*, was in all respects uniformly high. Attack by *Poria incrassata* and *P. monticola* was quite variable, however, with outer heartwood from at least 9 percent of the trees exhibiting no more than moderate resistance to these fungi. There was no indication that the variation in resistance among trees was related to the growing site or to the rate at which the wood was grown. However, there was a pronounced tendency for the outer heartwood to be more resistant to *P. incrassata* (but not *P. monticola*) with increasing diameter of the heartwood.

Within individual trees the heartwood resistance was not uniform but varied according to a rather definite pattern. This was true for all the fungi but of practical significance only with respect to decay by the two Porias. Resistance generally was progressively greater from the inner to the outer heartwood and from the upper to the lower part of the trunk. The radial differences typically were greatest in trunk sections with the most resistant outer heartwood, and there was limited evidence that maximum radial differences occur where large diameter and resistant outer heartwood are combined.

Except for white bands of internal sapwood, which had relatively no resistance, and for zones of dark brown heartwood, which were inclined to be more susceptible to Poria decay than the normal light and medium brown wood, color was not indicative of decay resistance. Differences in resistance were frequent among closely adjacent zones of wood, indicating in such cases local irregular distribution of the decay-controlling extractives.

It does not appear practicable to select western redcedar products for superior decay resistance other than perhaps in the case of split posts.

Loss of decay resistance in western redcedar heartwood may occur through leaching and apparently in other ways, possibly through chemical changes in the preservative extractives as the heartwood ages. Marked losses in resistance to all test fungi except *P. incrassata* were indicated for the heartwood of poles that had been in service 21 to 29 years.

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Seed Spot Tests with Tetramine-Treated Seed in Northern California

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THAT RODENTS are ravenous eaters of forest tree seeds is a fact well known by foresters. During a 3-year period the Denver Wildlife Research Laboratory, U. S. Fish and Wildlife Service, and several other private and public organizations experimented with tetramine (tetramethylene disulpho tetramine) to test its effectiveness as a rodent repellent and rodenticide when used with direct seeding. Some promising results were reported. Since then difficulties have arisen in the procurement of tetramine, and it is not now generally available. However, results of seeding tests in northern California are reported here to complement the record.

Blacks Mountain Test, 1953

One test area was a recently logged area of the Blacks Mountain Experimental Forest in the eastside pine type. Ponderosa pine (*Pinus ponderosa* Laws.) seeds were used, the tetramine treated seed being prepared by the standard acetone procedure. This procedure consists of the following steps:

1. Wash seed in pure acetone for five minutes.
2. Immerse seed for one hour in a one percent solution of tetramine in acetone.
3. Air dry seed for one-half hour to remove all surface acetone.
4. Place seed in a porous or un-

TABLE 1.—GERMINATION, SURVIVAL, AND CAUSES OF MORTALITY IN TETRAMINE TEST SEED SPOTS, PONDEROSA PINE, BLACKS MOUNTAIN EXPERIMENTAL FOREST, 1953

Item	Tetramine-treated seed		Untreated seed		Untreated seed in comparable area	
	Screened	Unscreened	Screened	Unscreened	Screened	Unscreened
	Percent of seed spots					
Germination	99.0	91.0	95.0	59.5	93.8	45.0
Stocked at end of growing season	67.0	23.5	53.0	10.5	52.5	2.5
Causes of mortality:						
Insects						
Cutworms	16.5	29.5	21.0	27.0	28.8	28.8
Webworms	0.5	1.5	0.5	0.5	.....	.....
Wireworms	2.5	1.5	3.5	1.5	1.2	2.5
Rodents						
Seed robbed	.....	5.5	1.5	25.0	.....	11.2
No germination[1]	1.0	3.5	3.5	15.5	6.2	43.8
Seedlings cut	0.5	17.0	0.5	9.5	.....	6.2
Deer (stepped on)	.....	0.5	.....	1.5	1.2	.....
Weather						
Drought	10.0	17.5	15.5	8.0	6.3	.....
Sunscald	.....	.....	.....	0.5	.....	.....
Erosion	.....	.....	0.5	.....	.....	5.0
Fungus	2.0	.....	0.5	0.5	3.8	.....
Total	100.0	100.0	100.0	100.0	100.0	100.0
Basis: Number of seed spots	200	200	200	200	80	80

[1]Rodents probably robbed most of the seed spots in this category. However, no direct evidence, such as seed hulls or excavations, was observed.

[1]Maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of California, at Berkeley.

capped container to allow further evaporation of the acetone.

Ten blocks, all within a semicircular area with a radius of 110 feet, were planted with stratified seed on May 7, 1953. A block consisted of 4 lines with 20 seed spots per line. Five seeds were placed in each seed spot. The four combinations of seed and seed-spot treatments assigned randomly to the lines in each block were:

1. Tetramine-treated seed protected by dome screens.
2. Tetramine-treated seed unprotected by screens.
3. Untreated seed protected by dome screens.
4. Untreated seed placed in unprotected spots.

The ground sloped gently toward the west at an average rate of about 5 percent. The soil, a reddish brown loam with granular structure and neutral in reaction, averaged approximately 3 feet deep and overlay lava bedrock of vesicular andesite. The soil structure, together with the topography, provided excellent drainage.

For comparative purposes four additional blocks were sowed on similar sites nearby with seed not treated with tetramine. These blocks had only two lines of seed spots. In one line seed spots were protected by dome screens, but the other line was unprotected.

Germination, seedling survival, and mortality data were recorded at 2-week intervals during the growing season. The last examination date was October 27, 1953.

Results.—Tetramine applied to ponderosa pine seed did not inhibit germination. In the screened seed spots, for example, 99 percent of the spots sowed with tetramine-treated seed had seed germinate, against 95 percent of those with untreated seed (Table 1). Furthermore, tetramine protected the seed from rodent depredations. Germination was significantly higher (by analysis of variance, Table 2) in the seed spots containing tetramine-treated seed than in the seed spots sowed with untreated seed. Statistical analysis also reaffirmed that protective screens are significantly helpful in obtaining germination in seed spots.

TABLE 2.—STATISTICAL SIGNIFICANCE OF DIFFERENCES IN GERMINATION, AND IN STOCKING AT END OF THE FIRST GROWING SEASON; TETRAMINE TEST, BLACKS MOUNTAIN EXPERIMENTAL FOREST, 1953

Source of variation	Germination	Stocking on October 27,1953
Blocks	*N*	*S*
Seed treatments	*HS*	*HS*
Spot treatments	*HS*	*HS*
Seed treatments x spot treatments	*HS*	*N*

N—not significant
S—significant
HS—highly significant

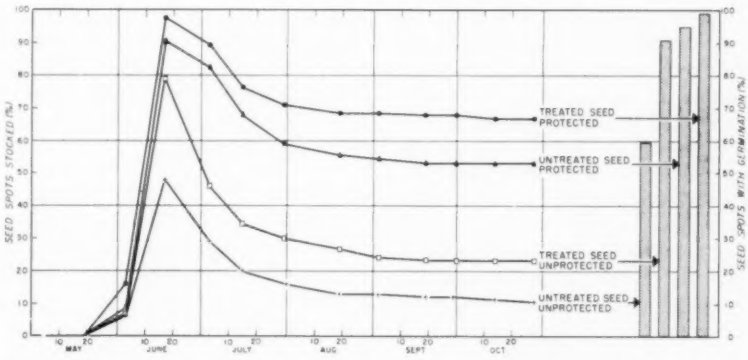

FIG. 1.—Stocking of seed spots, tetramine test, ponderosa pine, Blacks Mountain Experimental Forest, 1953.

The presence of tetramine in the unscreened seed spots probably provided some protection to the untreated seed in unscreened spots nearby. The amount of this protection is indicated by the germination of seed spots sowed with untreated seed. For the screened seed spots the difference in germination between the tetramine test area and the comparable area without tetramine was only 1.2 percent, but for the unscreened spots the difference between the two areas was 14.5 percent:

	Screened	Unscreened
	Percent germination	
Tetramine test area	95.0	59.5
Comparable area without tetramine	93.8	45.0
Difference	1.2	14.5

Other workers have recognized that protective screens, besides protecting seed from rodents, are beneficial in obtaining established seedlings for additional reasons *(1, 2)*. In this test the additional benefits of screens came mainly from protecting seedlings from cutting by rodents. The magnitude of the additional benefits are indicated by the ratios of the number of seed spots stocked at the end of the first growing season to the number of seed spots having germination. These ratios were:

Type of seed spots	Ratio of seed spots stocked to number having germination
	Percent
Tetramine test area:	
Screened seed spots	
Tetramine-treated seed	68
Untreated seed	56
Unscreened seed spots	
Tetramine-treated seed	26
Untreated seed	18
Comparable area without tetramine:	
Screened seed spots	56
Unscreened seed spots	6

Germination began sometime after May 20. Seed-spot stocking was low on June 3, but reached its maximum by June 17 and diminished thereafter (Fig. 1). Most of the seedling mortality occurred between June 17 and July 15 when darksided cutworms (*Euxoa mes-*

TABLE 3.—STATISTICAL SIGNIFICANCE OF DIFFERENCES IN DESTRUCTION OF SEEDLINGS BY RODENTS AND INSECTS DURING THE FIRST GROWING SEASON; TETRAMINE TEST, BLACKS MOUNTAIN EXPERIMENTAL FOREST, 1953

Source of variation	Destruction by rodents	Destruction by insects
Blocks	*S*	*N*
Seed treatments	*N*	*N*
Spot treatments	*HS*	*HS*
Seed treatments x spot treatments	*N*	*N*

N—not significant
S—significant
HS—highly significant

soria [Harris]) were especially active. Altogether, 24 percent of the seed spots were destroyed by cutworms. Rodents and drought were the other two major causes of seedling mortality. Other workers report that tree seedlings grown from tetramine-treated seed are protected against mouse feeding during the first few weeks after germination *(3)*. Seedlings produced from tetramine-treated seed at Blacks Mountain, however, were not protected from rodents or insects (Table 3). Screens were effective in excluding rodents from seed spots and also reduced insect damage.

Brush Mountain Tests

Tetramine also was tested by two experiments in the Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) type of northwestern California. Both trials were located on clearcut blocks of the Brush Mountain Unit, Six Rivers National Forest, near Salyer, California. Elevations of these areas ranged from 2,250 to 2,600 feet.

1952-1953 Test

Procedure.—The first test began on December 4, 1952, when 10 seed-spot blocks were sowed on a clearcut block 9.3 acres in size. The clearcut area was part of an east-facing 34 percent incline. The soil was more than 3 feet deep and was identified as Hugo stony clayey loam.

Five Douglas-fir seeds treated by the standard acetone procedure were placed in each spot. Each seed-spot line consisted of 10 spots and a seed-spot block included 2 lines. Spots in one line were protected by cone screens but the other line was unprotected. At the time of seed-spot sowing, the clearcut block was baited with tetramine-treated wheat grains, and the whole area was sowed soon after with tetramine-treated Douglas-fir seed placed by a cane-type automatic tree-seed planter.

Results.—The test was a failure. Seeds germinated in only 40 percent of the screened spots and 13 percent of the unscreened spots. By November 1, 1953, only 22 percent of the screened spots and 4 percent of the unscreened spots contained one or more seedlings.

Failure was caused principally by the acetone-tetramine treatment which both reduced and retarded germination of the Douglas-fir seed (Fig. 2). Germination tests in a greenhouse showed the untreated seed to be 76 percent viable; germination was completed 29 days after sowing. Only 28 percent of the tetramine-treated seed germinated, however, and germination continued at an even rate for 35 days. One treated seed germinated 68 days after sowing.

As in the Blacks Mountain test, the ratios of seed spots having germination to seed spots stocked at the end of the growing season show that screens do more than protect seed from rodents. These ratios for screened and unscreened spots were 55 and 30 percent, respectively. Early in the season, screens on this site prevented hardwood leaves and eroding soil from smothering tender seedlings.

1953-1954 Test

Procedure.—The second tetramine test in the Douglas-fir type began with the seeding of a 9.0 acre clearcut block November 7, 1953. The ground sloped toward the east at an average rate of about 20 percent. Soil was over 3 feet deep and was identified as Hugo clayey loam.

A seed-spot line of 100 stations was staked with stations approximately 20 feet apart. Each station consisted of three seed spots. One seed spot was seeded with tetramine-treated seed and then covered by a 4-mesh dome screen; the second spot was sowed with tetramine-

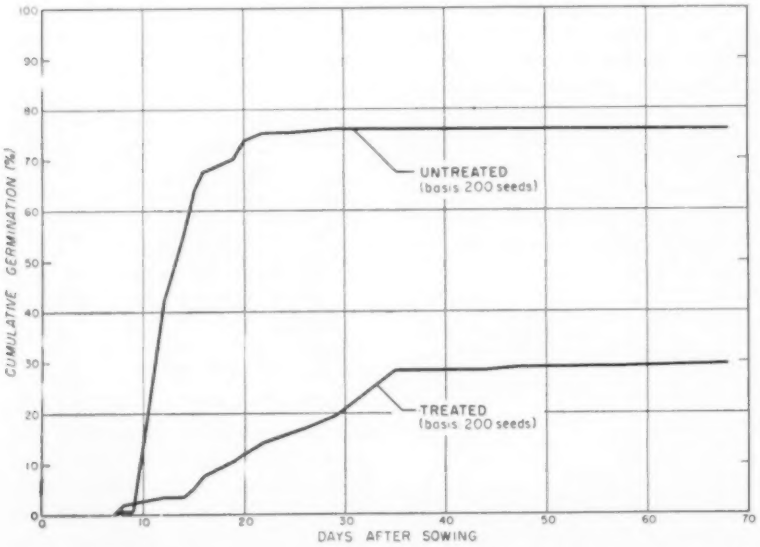

FIG. 2.—Cumulative germination, tetramine-treated and untreated Douglas-fir seed, South Olympic Tree Farm Lot TF-5 (1951) seed stratified at 36°F., Dec. 11, 1952 to Feb., 25, 1953, Brush Mountain.

treated seed but was left unscreened; and the third spot was screened but contained untreated seed. Five seeds were placed in each spot.

Ponderosa pine seed was used for this trial because viable Douglas-fir seed was not available. Seeds were "coated with a 10 percent yellow dextrin solution containing tetramine (1.0 mg. per gm. of seed)" *(4)*.

At the time seed spots were planted, tetramine-treated seeds were broadcast over the entire cutting block. In all, half a pound of Douglas-fir seed and three pounds of ponderosa pine seed, roughly 67,000 seeds, were distributed. Therefore, each acre received more than 7,400 seeds, obviously more than enough to kill a large population of rodents—if the seed treatment was effective.

To obtain an indication of rodent pressure upon seed spots on the area, 53 unscreened seed spots were sowed with untreated seed on November 2, before starting the test. Five days later 79 percent of the spots had been robbed.

Similarly, 50 seed spots were planted on December 10, 33 days after the test had begun. Nine days later 50 percent had been robbed. In 24 days 98 percent had been destroyed. Evidently, seed coated with dextrin and tetramine were ineffectual in eliminating rodents.

Results.—On the staked test line only five of the unscreened seed spots had seed germinate (Table 4). Definite signs of rodent pilferage, such as seed hulls and excavations, were found in 69 percent of the unscreened spots. More spots probably were robbed. The test, of course, was a failure.

The absence of any inhibitory effect on seed germination has been cited as one of the decided advantages of the dextrin-coating technique over the standard tetramine-acetone treatment *(5)*. This hypothesis was not confirmed by the Brush Mountain test. In the screened seed spots germination was 63 percent for the untreated seed but was only 35 percent for the dextrin-tetramine-treated seed. An average of 3.16 untreated seed germinated per spot compared to 1.77 for treated seed. Statistical analysis by t-test showed the differences to be highly significant.

TABLE 4.—GERMINATION AND STOCKING IN SEED SPOTS OF TETRAMINE TEST, BRUSH MOUNTAIN UNIT, 1953-1954

Item	Screened		Unscreened
	Tetramine	Untreated	Tetramine
		Percent	
Germination:			
Seed basis	35	63	1
Seed-spot basis	69	79	5
Stocking:			
June 9, 1954	64	77	5
August 30, 1954	56	69	5
August 12, 1955	45	59	5

Mortality during the first growing season was 20 percent for seedlings produced from treated seed and was 22 percent for seedlings of untreated seed. Protective screens were removed at the end of the first growing season.

Seed-spot stocking at the end of the second growing season was 45 percent for "tetramine" seed spots and 59 percent for "untreated" spots. Seed spots originally screened averaged 1.16 seedlings in spots seeded with tetramine-treated seed and 1.97 seedlings in spots sowed with untreated seed. Analysis by t-test indicated that these differences in stocking two growing seasons after sowing were highly significant.

Conclusions

1. The standard acetone-tetramine treatment did not inhibit germination of ponderosa pine seed.

2. The standard acetone-tetramine treatment inhibited and retarded germination of Douglas-fir seed.

3. The standard acetone-tetramine treatment protected conifer seed from depredation by rodents.

4. The dextrin-tetramine treatment did not protect conifer seed from rodents.

5. The dextrin-tetramine treatment inhibited germination of ponderosa pine—a finding contrary to experimental results reported by others.

6. Seedlings grown from tetramine-treated seed were not protected from rodents and insects.

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Protection of Ponderosa Pine Cones from Cutting by the Red Squirrel

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THE CUTTING OF seed cones and branches of conifers is a well-known food-gathering habit of tree-climbing squirrels. In western Montana the red squirrel (*Tamiasciurus hudsonicus richardsoni* Bachman) is the only species known to be responsible for the cutting of seed cones and branches of ponderosa pine (*Pinus ponderosa* Laws.). Its activity continues to hinder attempts by foresters to obtain successful natural reproduction of ponderosa pine, especially from the poor to fair seed crops normally produced by this tree species.

One promising method for controlling tree climbing by red squirrels is the banding of the trunks of seed trees with sheets of smooth metal (Fig. 1). A small-scale trial of this method was made in the fall of 1953 in a cutover ponderosa pine stand on the Kootenai National Forest in northwestern Montana.[1] Results from the test showed that a 20-inch wide sheet of smooth aluminum nailed in a continuous band around the trunks of isolated ponderosa pine trees, at a height of 5 to 7 feet above the ground, effectively kept squirrels from climbing.

This paper reports the results of a follow-up trial of the tree banding technique on the Lolo National Forest in western Montana.[2] The trial had two objectives: (1) to determine whether bands narrower than 20 inches would control climbing by squirrels, and (2) to determine the minimum distance between tree crowns necessary to prevent squirrels from jumping from unprotected trees to protected trees. The two tests used to attain these objectives will hereafter be termed the "Band Width Test" and the "Isolation Test."

[1]Squillace, A. E. Effect of squirrels on the supply of ponderosa pine seed. Northern Rocky Mountain Forest and Range Expt. Sta., Res. Note 131, 4 pp. 1953.

[2]Study designed by A. E. Squillace, forester, Intermountain Forest and Range Expt. Sta.

FIG. 1.—Aluminum bands used to prevent tree climbing by red squirrels..

Methods of Study

Band width test.—Three band widths were tried: 6 inches, 12 inches, and 18 inches. Each size was replicated three times, making a total of nine banded trees in the test. Three additional trees were left unbanded for use as controls.

Each of the trees selected was a mature ponderosa pine isolated from adjacent trees. The criterion of isolation was a minimum horizontal distance of 20 feet between the crowns of the test trees and adjacent trees.

Band widths were assigned to the trees at random. Each band was nailed to the tree so that its upper edge was 7 feet above ground line on the uphill side of the tree.

During the course of ripening of the 1956 cone crop the trees were checked for evidence of cone or branch cutting by the squirrels. All of the test trees bore cones. If no cones or branches were cut from a tree it was considered sufficient evidence that the tree had not been climbed by squirrels.

Isolation test.—Four degrees of isolation were tested: 0 feet, 5 feet, 10 feet, and 15 feet.[3] Three replications were installed here also, making a total of 12 trees in the test.

Each of the trees was banded with a 20-inch-wide, smooth alumi-

[3]After selection of the trees, isolation distances ranged from 0 to 16.3 feet.

num band installed in the same manner as in the Band Width Test.

Evidences of cone or branch cutting during ripening of the 1956 crop were checked as in the Band Width Test. Here again, all test trees bore cones.

Results and Discussion

In the Band Width Test trees without bands and those with the 6-inch and 12-inch bands showed much evidence of cone or branch cutting by squirrels. Consequently, the 6-inch and 12-inch bands were ineffective in preventing climbing.

Trees with 18-inch bands showed no evidence of cone or branch cutting by squirrels. Therefore, the 18-inch bands were effective in preventing climbing of the trees and cone destruction by squirrels.

In the Isolation Test all banded trees with an isolation of 5.3 feet or more showed no evidence of cone or branch cutting. In this case, therefore, a minimum distance of 5.3 feet apparently was sufficient to eliminate jumping by the squirrels from the unprotected (unbanded) to the protected (banded) trees.

It is not certain that a distance of approximately 5 feet is sufficient to discourage jumping by this species of squirrel. The usual maximum length of jump that a red squirrel makes when foraging in the trees under normal conditions is unknown. Observations[4] have shown that this animal, when deliberately frightened by man, is capable of jumping about 7 feet horizontally between trees and can negotiate a distance of about 10 feet in a diagonal jump with a drop of 12 feet. Since these distances were attained during escape stimulated by intense fear, it is reasonable to assume that they are close to the maxima for this species. An isolation of 7 to 8 feet might give a very high percentage of protection under normal conditions.

Another important factor in determining the amount of isolation required is the rate of lateral extension of the crowns. Branch growth will, in time, effectively reduce the isolation distance. This item must be considered in practical banding work and allowances made accordingly.

Before banding can be recommended for practical application it must receive further study. Additional experiments are planned which will investigate some of the following factors:

1. The minimum size band between 12 and 18 inches which will provide protection from climbing.
2. Cheaper and lighter materials for bands—possibly plastics, fiberglass, or specially processed paper products.
3. Improved methods of band attachment to the trees, especially those which will allow for band expansion as the trees grow.
4. Further confirmation of the minimum isolation required for protection from jumping, and investigations on the lateral growth of tree crowns.
5. The number of protected seed trees per acre necessary for an adequate seed supply. Seed-tree requirements are related to stocking standards, size of the cone crop, seedbed conditions, rodent control, and other factors affecting germination and survival. In the California pine region 5 to 9 seed trees 20 to 26 inches in diameter are considered an adequate number per acre in average seed years, if mineral soil seedbed is provided and rodents are poisoned.[5]

Summary

Banding isolated ponderosa pine seed trees with a sheet of 18-inch wide, smooth aluminum prevented red squirrels from climbing the trees and cutting cones and cone-bearing branches. Six-inch wide and 12-inch wide bands were ineffective. These results reduced the previously reported effective band width of 20 inches by 2 inches.

Protected trees (trees with 20-inch bands) with branches 5.3 feet or more distant from the branches of adjacent unprotected (unbanded) trees did not experience cone or branch cutting by squirrels. It is suggested that a 7- or 8-foot isolation might be adequate to prevent jumping by squirrels from unbanded to banded trees under normal conditions, since under escape conditions red squirrels have been observed to jump 7 feet horizontally and to span 10 feet in a downward diagonal drop.

Further studies are planned to investigate possibilities of increasing banding effectiveness at low cost.

[4] Field observations by K. N. Boe reported in the files of the Intermountain Forest and Range Expt. Sta.

[5] Fowells, H. A. and G. H. Schubert. Seed crops of forest trees in the pine region of California. U. S. Dept. of Agric. Tech Bul. 1150. 48 pp. Illus.

Effects of Cutting Methods on Advance Reproduction in Two Mature Mixed Coniferous Swamps in Upper Michigan

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CONIFEROUS SWAMPS of Michigan's Upper Peninsula cover about 1 million acres, or roughly 10 percent of the total forest land area. Their commercial value, second only to the northern hardwood forests, makes them of vital importance to the Peninsula's economic well-being. In addition to timber values involved, these swamps provide high-value habitat for many species of animals, and are of prime interest to game managers, sportsmen, and others concerned with wildlife and hunting. However, it is evident from a recent survey of cuttings *(5)* that the new stands developing on cutover swamps will be markedly different from and often inferior to the original stands. This is due to changes in species composition — typically an increase in the proportion of low-value hardwoods and reduced numbers of spruce *(Picea mariana* and *P. glauca)* and cedar *(Thuja occidentalis)*.

Logging of mixed coniferous swamps not only alters the pattern of advance reproduction but also influences subsequent seedling establishment. This is true for many forest types, but it is especially important where the advance reproduction is composed of a mixture of coniferous species, and survival and growth are hindered by aggressive sprouting and seeding of less desirable hardwood species. This report deals with the reproduction present in these stands before cutting and the effect of different cutting treatments upon it.

[1]The author is a forester at the Marquette, Mich., field office of the Station. The Station is maintained at St. Paul 1, Minnesota, by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of Minnesota.

Stand Description

Recent cuttings in two mature coniferous swamp stands on the Upper Peninsula Experimental Forest at Dukes, Michigan were the basis of this study. Neither stand had been cut for at least 50 years, and before that only a few scattered trees were removed. Deer browsing, which sometimes decimates reproduction in mixed coniferous swamps, was negligible in these areas.

Northern white-cedar was the predominant species in both stands. The composition of the stands before cutting is shown in Table 1.

TABLE 1.—COMPOSITION OF STANDS BEFORE CUTTING

Species	Percent of basal area[1]	
	Stand "A"	Stand "B"
Northern white-cedar	67	62
Black spruce[2]	12	26
Balsam fir	12	8
Hardwoods[3]	9	4

[1]Trees 1.0 inch d.b.h. or larger.
[2]Includes a few white spruce.
[3]Mostly red maple and black ash.

Basal area per acre in trees 1.0 inch d.b.h. and larger averaged 225 square feet in stand A and 190 square feet in stand B.

The age of the mature trees in these stands varied by species. Some spruce and cedar individuals were found to be more than 140 years old while the oldest balsam fir *(Abies balsamea)* noted was 100 years old. Stand heights ranged between 50 and 60 feet. Spruce trees were tallest, with balsam fir a close second; cedar was the shortest. The soil in each area was a muck type with the layer of organic material ranging in depth from about 3½ to 5 feet. The soil reaction was neutral to slightly alkaline.

Advance reproduction in both stands included very large numbers of balsam fir, cedar, and hardwood stems, especially in the smaller sizes. Most of the hardwoods were red maple (*Acer rubrum*) or black ash (*Fraxinus nigra*). The relative sizes of seedlings of different species were of prime importance in these stands as juvenile growth rates of the species involved show wide differences. Also, many areas were so overstocked with seedlings that the smaller ones appeared destined to be crowded out. Table 2, based on a sample of reproduction described later, indicates the occurrence and size-class distribution of the reproduction by species before cutting.

Methods of Cutting

Each stand was divided into six compartments of from four to ten acres each. One compartment was reserved as an uncut check area and the remaining compartments were randomly assigned one of the following cutting methods:

Light selection.—Poor risk trees and those of less desirable species were cut. This was the lightest cut and left an average residual basal area of 109 square feet per acre in 268 trees 4.6 inches d.b.h. and larger.

Shelterwood.—A well distributed overstory or seeding stand of vigorous, windfirm, genetically desirable individuals were left (Fig. 1). The residual basal area per acre averaged 52 square feet in 116 trees 4.6 inches d.b.h. and larger.

Diameter limit.—Minimum diameter limits were set to favor the more desirable species. In stand A

the limits were: spruce 11 inches, cedar 7 inches, and balsam fir 6 inches. The average residual basal area per acre was 31 square feet in 150 trees 4.6 inches d.b.h. and larger. In stand B, because of higher diameter limits and trees "missed" in logging, the residual basal area was considerably higher. Consequently, data from the diameter limit cutting of stand B are not included in this report.

Clearcut strips.—In each stand two strips, 75 feet wide and 300 feet long and running east and west, were clearcut through an otherwise uncut compartment. All trees 1 inch in diameter or larger were cut.

Clearcut blocks.—A total of seven blocks, each about 130 feet square, were clearcut in a checkerboard fashion. The stand between these blocks was not cut. All trees 1 inch and larger were removed.

Whenever possible spruce trees in good condition were left in preference to cedar and balsam. Almost all of the hardwoods were cut.

Logging Operations

Both areas were logged in midwinter by the same operator using the same equipment. Skidding, by crawler tractor and sled, was confined to a few main trails in most cases. Mechanical damage to the reproduction was negligible because of the usual deep snow conditions, and for the same reason seedbed scarification was practically nil.

No special provisions for handling slash were made. In the heavily cut areas the slash was concentrated to some extent to facilitate skidding. Large branches were lopped to hasten decay.

Reproduction Sampling System

In the fall prior to cutting, almost 2,000 systematically distributed and permanently located milacre plots were established for this study. Each plot was described as follows: (1) stocked or not stocked, (2) species of dominant reproduction, (3) height class of dominant reproduction, and (4) whether or not the reproduction was free to grow. In addition, one plot in every five was selected at random for a complete tally of all tree seedlings by species and height class. No attempt was made to distinguish seedlings from other forms of reproduction.

TABLE 2.—SIZE-CLASS DISTRIBUTION OF THE REPRODUCTION BEFORE CUTTING

Stand	Height in inches	Percent of milacre plots with 1 or more seedlings of—			
		Spruce	Balsam	Cedar	Hardwood
A	Under 3	19	93	61	52
	3-6	3	36	19	72
	7-36	2	11	17	58
	Over 36[1]	0	2	6	4
	Any size	21	94	69	89
B	Under 3	6	81	72	52
	3-6	4	53	42	69
	7-36	1	23	44	77
	Over 36[1]	0	6	21	29
	Any size	8	82	85	88

[1]Less than 1.0 inch d.b.h.

The plots were examined and classified in the fall before cutting and again in the growing season following logging. Depth and density of slash were recorded for each plot during this second tally. Depth was arbitrarily classed as shallow or deep, that is, averaging either less than or more than 3 feet deep. Density, or the proportion of the area of each plot covered by slash, was ocularly estimated by 25-percent classes.

Experimental Results

Changes in the reproduction were immediate and striking. The following discussion describes the reproduction before logging and the effects of logging upon the measurable characteristics of that reproduction. For this study, the data for the two clearcut methods of cutting were combined.

Logging slash.—A number of studies *(1, 2, 3, 4)* have proved that dense piles of coniferous slash have a harmful effect upon regeneration by covering over a proportion of the advance reproduction and by preventing new tree growth for a number of years. The role of slash upon regeneration when scattered or in relatively open piles is not fully known.

The amount and distribution of the logging slash in the study areas varied greatly among the methods of cutting. Table 3 is a summary of slash conditions noted in the examination of the milacre reproduction plots after logging. As might be expected, the intensity of cut is strongly correlated with the amount of slash. The clearcut tracts, with 46 percent covered by dense slash

FIG. 1.—Residual stand in an area cut by shelterwood method.

TABLE 3.—DISTRIBUTION OF LOGGING SLASH

Methods of cutting	Amount of milacre covered					Depth	
	0	1/4	2/4	3/4	4/4	Under 3 feet	Over 3 feet
	Percent of milacres examined					*Percent of milacres which had slash*	
Light selection	26.5	28.1	16.4	17.4	11.6	70.2	29.8
Shelterwood	10.2	22.6	14.2	25.2	27.8	47.3	52.7
Diameter limit	15.5	12.9	15.8	23.7	32.1	51.7	48.3
Clearcut	9.7	13.6	8.8	22.0	45.9	34.0	66.0

TABLE 4.—DEGREE OF RELEASE AND LOSS IN STOCKING FOLLOWING CUTTING

Cutting method	Percent of plots with the dominant seedling—		Percent of plots not stocked
	Overtopped	Free to grow	
Light selection			
Before	75.4	23.6	1.0
After	51.3	37.9	10.8
Shelterwood			
Before	72.0	27.5	0.5
After	19.5	59.0	21.5
Diameter limit			
Before	87.0	13.0	0
After	19.0	48.0	33.0
Clearcut			
Before	78.6	20.9	0.5
After	1.6	59.3	39.1
All areas			
Before	75.5	24.0	0.5

TABLE 5.—ABUNDANCE OF REPRODUCTION BEFORE AND AFTER CUTTING

Cutting method	Species	Percent of milacre plots with 7 or more stems of the species—		Reduction as a percent of milacres before cutting
		Before cutting	After cutting	
Light selection	Spruce	0	0	0
	Balsam fir	64.3	35.7	44.5
	Cedar	38.8	19.0	51.0
	Hardwoods	52.4	28.6	45.4
Shelterwood	Spruce	2.5	[1]1.2	50.0
	Balsam fir	71.2	23.8	66.6
	Cedar	72.5	32.5	55.2
	Hardwoods	62.5	22.5	64.0
Diameter limit	Spruce	0	0	0
	Balsam fir	77.1	16.7	78.3
	Cedar	20.8	6.2	70.2
	Hardwoods	50.0	8.3	83.4
Clearcut	Spruce	0	0	0
	Balsam fir	63.3	20.0	68.4
	Cedar	55.0	20.0	63.6
	Hardwoods	38.4	6.7	82.6
All methods	Spruce	0.6	0.3	50.0
	Balsam fir	68.4	25.4	62.9
	Cedar	49.1	20.9	57.4
	Hardwoods	51.9	18.4	64.5

[1] Actually 1.25 percent.

and only 10 percent free of slash, point up how important a factor logging slash can be in coniferous swamp regeneration.

Release of reproduction.—At the time of the examination of reproduction before logging, the dominant seedling on 75 percent of the milacre plots was overtopped by adjacent vegetation to the extent that it was classed as "not free to grow." Table 4 shows the degree of release resulting from the cutting methods tested. It is interesting to note that the amount of release is also closely correlated with the intensity of cut.

Stocking of reproduction.—Before cutting, 99.5 percent of all milacre plots examined were found to support at least one seedling of a commercially marketable tree species. Table 4 indicates the loss in stocking caused by logging. In almost every case where a milacre was classed as nonstocked after logging, the cause was a complete coverage of the plot by virtually impenetrable slash. This loss in stocking nullified to some extent the benefits of the release discussed above. Loss in stocking was equally shared by all species.

Abundance of reproduction.—To measure the abundance of the reproduction an arbitrary standard of seven or more seedlings per milacre, of the species being described, was set. Before logging 68 percent of the milacres had seven or more balsam fir seedlings (Table 5). The corresponding figure for cedar was 49 percent and for hardwoods 52 percent. Seven or more spruce seedlings were found on less than 1 percent of the plots.

Seedling abundance was reduced sharply by logging. The greatest reduction resulted from the diameter limit and clearcutting—about three-fourths of the plots meeting the abundance standard before cutting failed to do so after cutting. The light selection method caused the least damage; the reduction was less than half.

Relative dominance of species in reproduction.—A hardwood seedling or sprout, usually red maple or black ash, was the dominant member of the reproduction on 56 percent of the plots before cutting. A balsam seedling was dominant on 23 percent and a cedar on 20 percent. Spruce seedlings were never dominant. About 1 percent of the plots were not stocked. No evidence of trends or significant changes in relative species dominance was apparent as a result of logging by any method.

Size-class distribution of reduction.—No clearly defined changes in the size-class distribution shown in Table 2 were apparent after logging. The reduction in numbers of seedlings was well distributed throughout all size classes.

Summary

Two mature mixed coniferous swamp stands in the Upper Peninsula of Michigan were cut by five

different cutting methods. Some measurable characteristics of the reproduction were described as found in the uncut stands and after different methods of cutting.

Very large numbers of cedar, balsam fir, and hardwood seedlings were present before cutting. Most of them, about 75 percent, were being restricted in development by adjacent vegetation. Hardwood seedlings or sprouts were dominant on more than half of the plots. Balsam fir was the most abundant species. Most of the reproduction was under 6 inches in height although many cedar and hardwood trees in the 6- to 36-inch height class were noted.

Changes in the reproduction were generally related in amount to the intensity of the cut. Cutting released many seedlings, and many others were completely covered by slash with the result that the reproduction pattern was made much more spotty. Cutting did not cause a significant change in the relative dominance of the species or in the size-class distribution of the reproduction. The total numbers of seedlings of all species and size classes were sharply reduced by accumulations of logging slash.

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The Concentration-Yard Industry in North Georgia[1]

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DURING 1954 and 1955 a study was made of all lumber concentration yards—a total of 32—within a 40-mile radius of Athens, Georgia.

Concentration yards are common in parts of the South where small forest ownerships predominate. The lumbermen who work such holdings generally do so with portable mills, for they find it more economical to transport green lumber than logs. Because the production of such mills is small, they cannot readily place their lumber on the nation's market. The concentration yard fills the marketing vacuum. A yard typically buys green lumber from "roofer" mills, seasons, finishes, and perhaps grades the boards, and markets them. Yards vary in size and organization. Many stationary sawmills act as concentration yards in buying mill-run green lumber.

The present study was undertaken in an area where concentration yards are notably more common than stationary sawmills. Many of the yards were of the small type called planer mills; the distinction is one of size rather than of function. The purpose was to learn something of how this important segment of the southern pine lumber industry operates, and especially of the relationship between the yards and the mills from which they obtain lumber. To this end, personal interviews were held with the yard operators.

The Yards

All of the yards were on paved highways, and a few were near rail sidings as well. One-inch boards were their chief stock in trade, but 2x4's were handled also. Except that each yard had a planer, no generalizations can be made about equipment. The small yards had virtually no lumber-handling facilities, and even the large ones were not highly mechanized. Twenty-five yards air-dried their lumber. Only one yard kiln-dried all the lumber it handled, but four others had facilities for kiln- as well as air-drying. Two yards attempted to sell most of their lumber green, so as to take advantage of rapid turnover and avoid degrade during seasoning. Seven yards had sawmills on the premises; these were operated either part- or full-time, chiefly on logs brought in by farmers or independent loggers.

Twelve yards were large enough to market lumber primarily out of the state. They had an average of eight sawmills supplying them and generally referred to themselves as concentration yards. Yards de-

[1]The data are from a thesis presented in partial fulfillment of the Master of Forestry degree at the University of Georgia. The study was conducted under the direction of A. C. Worrell and J. R. Parker.

pending primarily on local markets drew from an average of three sawmills and called themselves planer mills. The concentration yards tended to run full-time, while planer mills operated intermittently. At the time of the survey the operators of the 32 yards were securing lumber from 159 mills.

Five of the yards were in corporate ownership, 13 were held in partnership, and 14 were individually owned. When asked "Who owns this yard?" one operator replied, "Me and the bank." However, while the yards themselves enjoyed normal sources of credit, the mills that supplied them did not. Hence all but a very few yards had a financial interest in the tributary mills.

How the Industry Operates

Although the capital outlay for a portable mill is small, the yards were giving financial aid to 86 mills, mostly those operating part-time. Thirty-four of the mills in the area required little or no aid; these tended to be full-time enterprises that had accumulated working capital over the years. Thirty-nine mills were owned outright by the yards. The yards would prefer not to own mills because ownership requires meeting minimum-wage and Social Security regulations. To insure a flow of lumber sufficient to protect their markets, however, the large yards found ownership necessary: owned mills produced a far more dependable supply of lumber than financed mills.

Financial assistance frequently took the form of cash advances for payrolls or equipment, with loans being repaid as green lumber was brought in. More often, the yard operator provided the stumpage in which the mills operated. This brought him a double benefit. It assured him of a supply of lumber and also prevented his various suppliers from competing with each other for stumpage and thus bidding up prices.

The procurement of stumpage was a major problem. The lapse between the time timber was bought and the green lumber produced was reported to range from one month to a year. The average was five months. The difficulties of financing, the increasing competition for stumpage, and the uncertainties of lumber price behavior all discouraged the acquisition of stumpage in advance of immediate needs. Several operators reported trouble in keeping a two months' supply of stumpage ahead of the saws.

The yard operators complained that careless sawing at some of the portable mills produced boards too thick or too thin to finish properly, but they were less concerned about grade. As a general rule, the mills were not cutting for grade, since that required frequent hand turning of the log on the carriage and thus slowed down production. Trading for mill-run lumber also obviates grading each board as it is brought in to the yard. Yard managers were reluctant to pay the premium that would have been necessary to improve grade yield. Several had tried persuasion rather than dollars to stimulate cutting for grade, but with little effect.

Marketing

Two lumber market areas were recognized in this study—the Georgia market, and the out-of-state market. The yards tended not to mix their markets. About half marketed most of their lumber locally, while one-third shipped primarily out-of-state. The rest utilized both outlets.

Out-of-state shipments went to South Carolina, Florida, Kentucky, Tennessee, Illinois, Michigan, Missouri, Ohio, Pennsylvania, New York, New Jersey, and Connecticut.

The large yards tried to hold markets that would take their production with a minimum of selling effort. Thus they dealt with brokers, commission men, and industrial buyers, all of whom prefer carload lots. As a rule this meant out-of-state shipment. Since small yards could not meet the needs of brokers and commission men, their only recourse was to sell locally to contractors and other lumber users. Thus a yard's output and location with respect to other yards defined its market area.

Six Athens retail yard owners were interviewed in connection with this study. They handled both local lumber and some from the West Coast and North and South Carolina. The retail men stated that they were losing their trade for local framing lumber to the nearby concentration yards. One said, "We don't handle much framing lumber because people can get it from a yard, or if the order is big enough the yard will deliver it. We give more service than the concentration yards do, but we have to charge for it."

Lumber Price Determination

Lumber consumption and prices are of course determined by the general level of business activity, especially housing starts and the like. Competition with western woods and substitute materials also affects the price of concentration-yard lumber. In effect, prices are determined not by the concentration-yard operator but by forces largely beyond his control.

Nevertheless, most yard owners said their selling price was determined by the sawmiller's price. Only seven recognized that lumber prices are set in the nation's market.

In dealing with their supplying mills, three yards followed a price leader. That is, they paid what some other mill paid. One manager said he paid just enough to preserve business relations with his suppliers—doubtless a competitive price. Some operators published a weekly or biweekly price list based on the current market for finished lumber and their margin for doing business. Others contracted with their sawmillers for delivery of lumber at a specific price that took into account such factors as logging conditions and length of haul. Lumber was trucked an average distance of 21 miles from mill to yard—the range was 8 to 57 miles, or, if the two extreme cases are omitted, from 11 to 35 miles.

A surprising number of yard operators were willing to supply in-

formation on stumpage costs and the prices they paid and received for lumber; 28 of the 32 yards responded, though not uniformly to each item. Table 1 summarizes the price information, in index form.

Though the data are limited, some inferences may be drawn. Yards with above-average selling indices tended to pay more for green lumber and for stumpage. That type of yard ownership may also bear on the price of finished lumber is implied by the seven point spread between yards singly owned and those held in partnership. The relation between yards with out-of-state markets and those selling locally may be explained by the size of the businesses. There was a five point spread between yards financing at least half their suppliers and those financing less than half. The implication is that independent sawmills received a better price per M than financed mills.

For the industry as a whole, the greatest single item of cost was stumpage, which accounted for about a third of the value of the finished lumber. In general, only 25 percent of the selling price of finished lumber was available to cover the yards' operating costs and profit and risk.

TABLE 1.—AVERAGE INDEX REPORTED FOR STUMPAGE, GREEN LUMBER, AND FINISHED LUMBER
(Average finished-lumber price for all yards = 100)

Yards	Yards responding	Yard's lumber value	Mill's lumber value	Stumpage
	Number			
Financing at least half their mills	7-8	96	73	33
Owned individually	11-13	96	73	33
With out-of-state markets	10	97	74	34
All	22-28	100	75	34
In corporate ownership	3-4	101	76	36
Financing less than half their mills	12-18	101	77	35
With chiefly local markets	12-18	102	75	34
Owned in partnership	7-12	103	77	35

A Look Ahead

The combination of concentration yard and portable sawmill has become an integral part of the southern pine lumber industry. Portable mills are ideally suited to operating on tracts with only a small amount of stumpage, and the concentration yards furnish these mills with a much-needed marketing service, not to speak of stumpage supplies and working capital.

As the rural population continues its shift to towns and cities, however, less labor will be available to the industry. And as more timber owners undertake forest management, they will trade harder for stumpage. Too, the ever-expanding paper industry uses the same kind of timber that now finds its way to concentration yards. As these trends continue, modernized stationary sawmills are likely to come into their own. Such mills could pay better wages, offer more attractive working conditions, and compete for managed timber.

The number of yards near Athens was smaller in 1955 than three years previously. Competition for stumpage and from western lumber had forced some producers out. In one community alone four yards had gone out of business. Thus the trend in the study area is toward fewer yards and mills, but the end is by no means in sight. The yard-mill combination is likely to play a useful role for some years to come.

America's Natural Resources

The book, *America's Natural Resources*, a review of which appears on page 470 of this issue, may be purchased by readers of the JOURNAL at a discount of ten percent from the publisher's list price of $3.75. Orders, accompanied by remittance, should be placed through the Society of American Foresters, 425 Mills Building, Washington 6, D. C.

A Re-orientation of Forest Marketing Research

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MARKETING has long been one of the more commonly accepted research areas of forest economics. Prior to 1940 marketing studies were relatively rare in forestry, yet even then few would claim this as a new field of research endeavor. Today nearly all of the forest experiment stations, and many of the forestry schools, are conducting studies of one kind or another under the general heading "Market Research." It seems pertinent, therefore, to raise the question, "What can market research be expected to contribute to forestry?" The answer, naturally, depends on how much, and what kind of, market research.

Without attempting any thorough review of previous forest marketing research one comment may be made. Past effort has been heavily slanted toward problems of the small forest landowner, particularly those of the farmer. A frequent result has been the listing of log, bolt, and in some instances stumpage buyers, together with their addresses, product specifications, prices paid, whether delivery is accepted at the mill or roadside, etc.[2] The immediate usefulness of such information is readily granted, but it in no way indicates the scope of market research. Such studies are a necessary first step—the opening measures of the first movement. Judged by these first measures the composition is well worth completing, but unfortunately little effort has been made to study forest marketing problems beyond the preliminary phase.

Many studies have implicitly assumed that if knowledge of market outlets were more widely disseminated better woodland management would follow. Indirectly, this hypothesis has provided the orientation for most forest product marketing research. Aimed toward increasing the returns to stumpage producers, market research in forestry has been almost entirely producer-oriented.

It is the author's belief that a change in emphasis is needed if market research is to fulfill its very significant potential—a change from *producer*-oriented to *consumer*-oriented market research. Past studies have contributed much, and certainly efforts directed toward solving the marketing problems of producers will be of continuing importance. But the emphasis should be shifted from the producer to the consumer. This article is an effort to explain why the suggested change in emphasis should be implemented without delay.

Areas of Market Research

Market research may be divided into five major categories:

1. Basic economic research.
2. Studies of market organization.
3. Product research.
4. Sales research.
5. Research concerned with marketing policy.

Of these five only the first three will be discussed. The latter two, sales research and marketing policy research, while equally important, are peculiarly restricted in scope and application to the corporation or organization studied and are for this reason omitted from further consideration. Nor will any defense be made for this particular classification of market research; it was chosen only because it emphasizes the change in orientation that is believed necessary. For with the exception of the first category, basic economic studies (and actually this exception is more apparent than real) all classes are consumer-oriented rather than producer-oriented. The discussion which follows is intended to bring out how far-reaching this re-orientation really is.

Basic Economic Studies

The primary objective of basic studies in the field of marketing is the identification of those variables affecting long-term consumption of forest products, and the determination of their relative significance. Early efforts at demand analysis made little use of statistical procedures, and some rested on a decidedly weak economic foundation. Wheeler's work (*9*), followed by that of Vaux (*7*), might be taken as the first real contributions to empirical forest product demand analysis. The Reappraisal Reports (*5*), the Timber Resource Review (*6*), and the Stanford Report (*4*) should also be mentioned. Probably because of a primary concern with predicting future wood consumption these three studies contributed less to an understanding of the basic factors influencing forest product demand and supply than might have been possible—or anticipated.

Holland's recent empirical analysis of factors affecting consumption of lumber (*2*) represents an important forward step. If measured only in terms of statistical significance Holland's work may seem disappointing. The real contribution of the study, however, lies in its revelation of both tech-

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[2]The author feels free to comment since he has published a report of this nature (*1*).

nical and data-source problems that must be solved before better results can be achieved. Major difficulties in applying the powerful tools of modern econometric analysis do not lie in mathematical statistics but in the lack of knowledge of forest product markets. Econometric analyses are no better than the basic models employed: better models can be formulated only when more is known about the markets themselves.

To a very important degree these basic economic studies point the way for other market research. Partially demonstrated by Holland's work, this may be further illustrated by a study currently in progress. Recently the author has been investigating some of the factors influencing the demand for hardwood flooring. Data of production, imports, exports, and mill prices are at hand, along with statistics pertaining to competing materials, population, residential construction, etc. These data will be processed by several analytical techniques and useful information should result. But suppose one were to ignore the data problems and try to set up a definitive study on the demand for hardwood flooring: What questions would arise?

One of the first, and a crucial one, would be: Who decides whether a new house is to have hardwood floors, tile, or wall-to-wall carpeting? Once this had been determined, other questions would follow. What factors are important to this decision-maker? Price will naturally be an important one, but what price? The consumer's price will certainly not be the mill price! What is a retail price for flooring, and who sets it? What are the channels through which flooring is transferred from the mill to the ultimate consumer? To each of these, and to most similar questions, one must answer—we don't know!

It might be supposed that information on the production side would offer fewer problems, and it is true that data on mill output and mill prices are available, but are these the significant factors affecting mill operators? How about labor costs, or stumpage costs, or inventories, or producer's market expectations, or freight rates, or — ? Again the reply must be, we don't know. Yet these and a host of similar questions must be answered before a definitive study of hardwood flooring demand can be set up.

The foregoing should not be interpreted as a suggestion that demand studies be delayed. Much can be learned from careful analysis of presently available data and there is need for far more testing of techniques and methods. The problems posed by analysis of demand for forest products are not exactly paralleled by those in other fields, yet there seems no real reason why continued efforts along this line would not meet with the same degree of success that has been achieved in other areas. The steel industry, the oil industry, the automotive industry, agriculture, and many other industries are putting great effort and large cash sums into basic demand research. These studies are paying off in dollar terms, not so much through a direct reflection in increased sales, but because major business decisions may be predicated on their outcome. Compared to productive processes in the above industries, timber production is a long-term affair. For this very reason forest industries should benefit even more from such studies.

It seems reasonable to expect basic research of this nature to be a major function of universities and forest experiment stations; yet industry itself, particularly through its various trade associations, could do much to further such studies. Without their cooperation a good deal of the necessary data will be difficult to assemble, and without financial support few studies will be undertaken.

Studies of Market Organization

Market structure studies have as primary objectives the detailed determination of the mechanism whereby a product is transferred from the producer to the consumer, and the underlying reasons for the particular institutional mechanism identified. Frequently these studies also appraise the efficiency of the market and point the way to structural changes which may improve its operation.

The lack of knowledge of the structure of markets has been referred to as a serious handicap confronting fundamental economic studies. As a matter of fact, surprisingly little is known of the actual market structure of even so basic a market as the one through which lumber moves. We know about how many mills produce the product and approximately how many wholesale and retail yards are primarily concerned with its distribution. Beyond this our knowledge is at best fragmentary. What, for example, might one reasonably identify as a "typical" retail lumber yard? How large in terms of board feet of lumber handled? How do these yards vary with respect to other building materials that are sold along with lumber? How does a midwestern yard vary from those in the northeast, or the west, or the south? More important, how do they get their supplies? How many retail yards purchase directly from mills and how many operate primarily through wholesale yards? What proportion of their supplies come from each source? How does this vary with location, with size, and with species? Are there wholesaling centers for distributing lumber to outlying retail yards, and if so, how far do these centers extend their influence. Is competition primarily on a service basis, or is price competition a factor? How prevalent are retail or wholesale chains? Is the self- service retail yard—the so-called cash and carry —making important inroads in this field? What changes have been or could be instituted to take advantage of the current do-it-yourself movement? What determines retail lumber prices, and how do they vary from mill prices?

This is a small sample of the kind of questions that need study. Partial answers are at hand for

many. Almost certainly some individuals engaged in the business have a fairly comprehensive knowledge of a few of these points. But until considerable research has been completed neither detailed information nor adequate aggregate data on a regional or national basis will be available.

To fill these gaps, and incidentally facilitate more basic studies, would seem sufficient reason to warrant timber market structure research, but larger benefits would also accrue. Possibilities of altering markets so as to encourage forest practices can best be evaluated if market structure is well understood. One may observe, for example, that the West Virginia mine timber market seems very unsteady and, from the forest producer's standpoint, disorganized in its operation. Instead of serving as a profitable outlet for low-quality hardwoods, it frequently siphons off high quality timber at reduced prices and thus depletes, rather than builds up, forest growing stock. Returns to the producer are low, hence practice of forestry is not encouraged.

A study of this mine timber market was recently completed by Webster at the Northeastern Forest Experiment Station (*8*). Among his conclusions Webster states that:

> Elimination of "middlemen," notably timber agents, is not at all likely to succeed as a means of increasing returns to forest landowners. Were it possible to eliminate them—a doubtful matter in itself—mining organizations would take steps to encourage their reentrance into the market as a means of assuring future supplies.
>
> The highly organized nature of mine timber procurement suggests that use of high-quality timber in West Virginia coal mines may result largely from a contrasting lack of organization in the procurement of other forest products.

From the results of this study it appears highly unlikely that mine timber markets can be successfully altered by working with stumpage producers alone. These producers are passive elements in the market structure. The market is organized from the mine timber consumer downward, not from the producer upward. Past or future studies may disclose that low-quality materials are well suited to mine timber use, or that higher prices could be paid for mine timbers. Such findings, however, cannot be expected to alter this market significantly as long as its present structure is maintained.

The mine timber example is by no means unique: The same deficiencies are found in almost every product field. Present ignorance of how markets for forest products are organized makes this one of the most fruitful research areas in the whole chain of problems extending from the tree to its final consumer. Studies to determine the relationships between various product markets could scarcely be labeled less important, although logically they would seem to follow or accompany, rather than precede, single market organization projects.

As with the basic studies previously discussed, it would appear that primary responsibility for research of this type should rest with the universities and public agencies. And to an equal extent, cooperation of industrial trade associations would be mutually beneficial.

Product Research

Product research is most commonly thought of in terms of technological development and improvement of new or existing products. Market research in the product field encompasses the nonengineering aspects of developing new or improving existing products—packaging, product-naming, determining the competitive position of the product, etc. Usually studies of consumer preferences are involved. Such research has as its general objective the increased sale of the products under study through discovery of underlying factors which influence the acceptance of the product by the consumer.

Studies in this area have become almost commonplace with many industries. Among forest product manufacturers the paper industry has been fairly active. To most wood producers, however, this kind of research has been almost completely bypassed. The wide variety of new paper products and, even more impressive, the steadily increasing per capita consumption of paper stand out in sharp contrast to the wood product field in general. The extent to which the contrast stems from market research activity is a moot point, yet it seems quite possible market research has played an important role. Surely knowledge of what consumers like or dislike about the product, what competitive products have to offer, and so on, places a producer in a much stronger position than one operating blindly.

In their text on marketing research, Lorie and Roberts (*3*) make the following statement:

> An Army commander who failed to consider alternatives to his current disposition of troops until the enemy had attacked would be subjecting his troops and his position to unnecessary peril. Similarly business executives who react only to the aggressive and successful action of competitors or to internal frictions subject their enterprise to unnecessary disadvantages.

For nearly half a century a sizable fraction—some would say nearly all—of the wood products industries have subjected their enterprises to this kind of unnecessary disadvantage. In fact an even stronger indictment might be made of many: they have remained complacent (perhaps resigned is a better word) in the face of aggressive and successful action of competitors; they have not even reacted.

It is common knowledge, for example, that the competitive position of lumber in the construction industry has deteriorated over the past few decades. This is particularly significant since construction accounted for some 73 percent of all lumber consumed in this nation in 1953 (*4*). Part of the answer may rest with the changing price relationships between lumber and its competitors; part may be traced to certain technological advantages inherent to steel, glass, plastics, brick, and aluminum. Market research could do much to establish the comparative importance of these factors and it could do far more.

Who determines what goes into

a house? Is it the contractor, the architect, the ultimate buyer, or who? Ultimately the home owner is the consumer, but a house is purchased as a "package deal" made up of wood, glass, plumbing, roofing, flooring, landscaping, location, credit terms, and numerous other components. How important is lumber in this package? If the industry cares about knowing, it might consider asking the consumer through market research.

A study of contractor preferences between lumber and competing materials or between different species of lumber should be highly revealing. Informal conversations between the author and a few contractors in his home area, for example, produced several reasons for a recently-observed decline in the use of southern pine. Some of the stated reasons were probably based on misinformation; some were undoubtedly founded in fact. But whether valid or not, the stated "reasons" constitute important barriers to the use of this material. Long before a decline of anything approaching a similar magnitude had been suffered in the sale of, say, a name brand men's shirt, the manufacturer would have had a research team out to discover why.

It may well be that contractors play an important role in determining what goes into a particular piece of construction, but surely the architect is also influential. What is the attitude of architects toward use of wood? How might these attitudes be influenced? To indicate how little is known along these lines (and incidentally raise an interesting question) one need only ask how many courses in the use of wood are now offered in schools of architecture and design, and how does this compare with instruction in the use of steel, brick, glass, or concrete?

Over the years both contractors and architects must produce what the buying public wants. Much could be learned by studying the changing pattern of consumers' preferences in house design, in interior trim, and their reasons for liking or disliking particular features such as wood panelling or wooden windows. Perhaps even more informative would be studies aimed at diclosing the influences which help mold consumers' likes and dislikes with respect to use of wood in residential construction. What part is played by the widely circulated magazines catering to home owners, and in what income classes is their influence most significant? Who decides upon the materials to be used in the larger housing developments, and what factors influence his decision?

The general lack of information along these lines is not confined to primary industries such as lumber. The furniture industry, for example, while highly dependent on style, has devoted surprisingly little research effort to determining consumer tastes by income strata or by locality or by other categories. One might hazard a guess that many furniture companies have little real knowledge of the kind of home their product goes in, though it would seem that such knowledge is important if designers hope to forecast product demand from house construction statistics. In some cases this apparent reliance on past experience and personal judgment is well justified; in many it is simply an expression of complacency which wood product manufacturers can ill afford. As with most research activities there is much variation: Some furniture manufacturers are both conscious of its possibilities, and very active in market research. Compared with many other industries, however, marketing research has been little recognized by the furniture industry.

One other phase of product research in marketing should be mentioned—the role such research could play in the development and pre-testing of new products. Given the chance, market research will often point the direction in which innovation is needed or desired, thus providing some guidance to technological development. After the new products have been developed, market research can test their acceptability prior to full-scale production. The advantages of both aspects are obvious.

Product research in the marketing field offers wide opportunities for all kinds of research organizations. Studies of broad interest might well be initiated by public agencies and universities. Trade associations should either sponsor or conduct research in their specific areas of interest, while corporations could well afford to invest in market research directed toward the products they produce.

Conclusion

The fact that wood products often pass through several manufacturing stages before consumption does not lessen the ultimate dependence of forestry upon consumer markets. When asbestos shingles replace wooden ones, or steel beams replace wooden joints, or architects specify pre-cast concrete instead of wood, or contractors substitute cork tile for hardwood flooring, or unitized steel kitchen cabinets replace wooden ones, or the American housewife switches her preference from wooden to metal bedroom furniture, the demand for the raw material, wood, is lessened and the opportunities for forest management decreased. Commercial forestry is as dependent on product sale as any shirt manufacturer, or automobile corporation, or candy company.

Much of the required market research is the direct responsibility of the product manufacturer. But a very significant portion should be accepted as a primary responsibility of federal, state, and university research staffs. Ample precedent for federal- and state-sponsored forest market research is at hand in numerous and effective studies of agricultural marketing problems. The same reasoning which justifies public expenditures for agricultural market research applies equally well to sponsorship of many forest market problems. Strong and vigorous forest management cannot be expected unless strong and vigorous markets exist for the product of that management. Markets exist primarily to

satisfy consumers' wants, not producers', and consumer-oriented market research is as vital to good forestry as any other kind of study. Commercial forestry will suffer if silvicultural, entomological, pathological, and other types of research are not furthered. It will die if markets for wood products disappear.

If one were to attempt a capsule summary of foresters' past attitudes toward market research, the following might well result: Here is the wood I've helped nature produce. Where can I sell it? Admittedly this is a legitimate attitude for field foresters. But the men engaged in market research activities must change their approach if this question is to have attractive answers. It is just possible that foresters' attitudes should eventually change—to one of saying "Tell me what products are wanted by consumers and I'll produce the kind of wood that will best satisfy the demand." Then forestry will have made a major forward step, and forest management will take on a new and vital significance.

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Chemical Debarking Offers Means of Utilizing Pine Thinnings

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IF PLANTATION thinnings could pay for themselves, more plantations would get better management. However, most of the products for which pine thinnings can be used require that the trees be peeled. Hand peeling is a tedious and time-consuming job. Machine peeling calls for specialized equipment. So in an attempt to find a cheaper and easier way to peel pine thinnings in southern Illinois, a test was made recently of a newly developed chemical debarking process (*3*). Specifically, the objectives were: (1) to determine the effectiveness of sodium arsenite for debarking shortleaf pine (*Pinus echinata* Mill.), and especially (2) to determine the time and cost of chemical debarking of shortleaf pine using row and selection methods of thinning.[1]

Method of Treatment

Eight ⅕-acre paired plots were selected in unthinned 18-year-old shortleaf pine plantations. In half the plots, all the trees in every third row were treated with sodium arsenite. In the other plots trees were selected on the basis of quality and spacing, the objective of

[1]Sodium arsenite is a poison and should be used with extreme caution. Be sure to read the instructions on the label of each container.

TABLE 1.—AVERAGE TIME REQUIRED TO APPLY CHEMICAL DEBARKING TREATMENT

Block	Thinning treatment	Treated trees per plot	Time required	
			Per plot	Per tree
		Number	*Man minutes*	
1	Row	66	172	2.6
	Selection	58	172	3.0
2	Row	53	148	2.8
	Selection	61	164	2.7
3	Row	61	156	2.6
	Selection	61	[1]204	3.3
4	Row	66	164	2.5
	Selection	64	184	2.9
Means	Row	61.5	160	2.6
	Selection	61.0	181	3.0

[1]Heavy honeysuckle impeded work.

FIG. 1.—Removing the bark prior to treatment. In this instance a mattock blade was used.

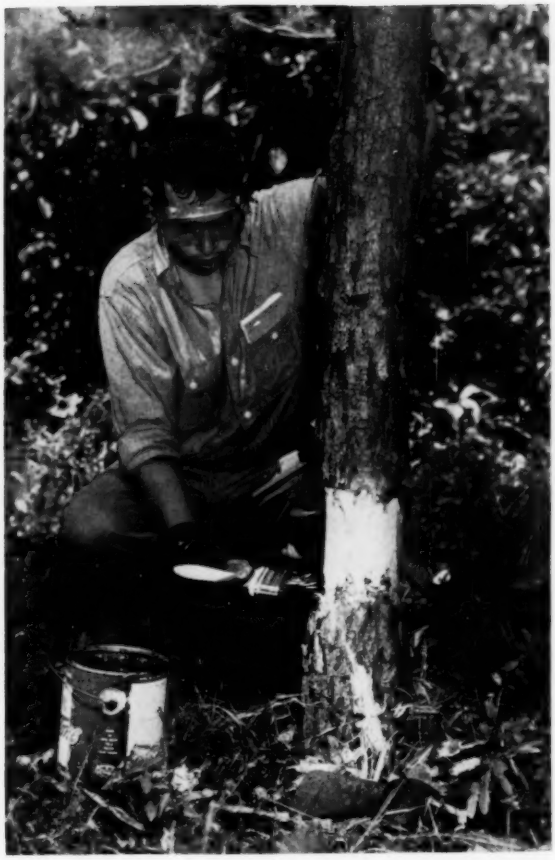

FIG. 2.—Applying sodium arsenite solution to the exposed wood. Note the use of rubber gloves and goggles as protective coverings.

course being to remove the poorer trees and relieve crowding. About the same number of trees were removed in each "selection" plot as were removed in the adjacent "row-thinned" plot (Table 1). The diameter of the treated trees averaged 5½ inches and ranged up to 8 inches.

The trees were treated in mid-May according to the directions outlined in a publication of the New York State College of Forestry (*3*). The work was done with a 4-man crew. Three men, using sharpening spuds made from auto springs, peeled off strips of bark encircling the trees (Fig. 1). The width of the peeled girdle was approximately the same as the diameter of the tree. The fourth man painted the freshly peeled surface with two coats of undiluted "Atlas D" debarking compound[2] (Fig 2).

Time and Cost of Treatment

It took an average of 2.6 man-minutes to treat a tree in the row thinning plots and 3.0 minutes for selection thinning. A comparison of hand and chain-type machine peeling in northern Illinois (*4*) showed that chemical debarking was faster than hand peeling or machine peeling.

Moreover, it may be possible to decrease the amount of time required to treat trees with sodium arsenite still further. Rushmore (*2*) reported satisfactory results by frilling the trees, a faster way to girdle than the one described here. Other investigators have reported satisfactory results with only one coat of sodium arsenite.

Approximately 100 trees were treated per gallon of solution. At the rate of $1.00 per hour for labor and $2.50 per gallon for the poison, the total cost per tree was 6.8 cents for row-thinned trees and 7.5 cents for selection-thinned trees.

Results of Treatment

By the following spring the bark had loosened to the extent that large sections were easily removed by hand after a start was made with a hand ax or debarking spud (Figs. 3 and 4). Although the bark did not fall off the tree by itself,

[2] "Atlas D" debarking compound is a commercially prepared water solution containing 3.77 pounds of sodium arsenite per gallon. In addition, it contains an animal repellent and a green colored dye.

FIG. 3.—After an initial start with an ax, the bark was readily removed in long strips by hand.

FIG. 4.—Trees exhibiting uniformly clean peeling characteristics in row-thinned plot.

the loosening effect was quite general and no areas of tight bark were observed. The side branches could be trimmed much easier than on live trees, and the bark around the branch stubs was loose and came off readily. It was apparent that probably all but a small portion of the bark would be knocked off the posts during the normal felling, bucking, and skidding operations.

Insect damage and rot in the wood of the standing trees were negligible although evidence of some insect activity could be seen in the loosened bark, and blue stain was present in the wood. The chemical apparently has an inhibiting effect upon insects because adjacent pine trees that were girdled but left unpoisoned had much more insect damage in the wood than did the treated trees. Freedom from insect damage and rot is a distinct advantage because damaged posts soak up excessive amounts of preservative, thus adding to the cost of the posts (*1*).

Chemical debarking with sodium arsenite is an effective way to remove bark from shortleaf pine trees offering promise as a means of utilizing plantation thinnings of fence-post size, both for commercial and home use.

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Notes

El Sabino, The National Tree of Mexico

WHEN MEXICO decided to select a national tree in 1921, there was no contest. For wide distribution and beauty there were few competitors. For majesty there was none.

The winner was *Taxodium mucronatum* Ten., a close relative of the baldcypress (*Taxodium distichum* [*L.*] Rich.) of the United States. It was called *Sabino* by the Spanish, using their common name of *Juniperus sabina* of Europe. It has a variety of tongue twisting names in the native Indian languages and that of the Aztecs, *Ahuehuete*, has come into wide use—wider than the Spanish Sabino. The species has been made particularly famous by the Grand Tule Tree of Oaxaca, reputed to have the largest diameter of any tree in the world.

The species is easily distinguished from the baldcypress as the latter is characterized by "knees" emerging from the submerged roots, has smaller cones, grows near sea level, and produces valuable lumber. The "knees" are absent in the Sabino; it grows mostly above 1,000 feet in elevation. It has little economic value except for minor local use and checks badly when air dried. The baldcypress is deciduous, while the Sabino is paradoxically deciduous and evergreen. New needles come out a few weeks before the fall of those of the preceding year. In some years, particularly in the North, cold weather may delay needle growth, resulting in a period when foliage is mostly brownish or most of the limbs may be bare.

The tree is found in nearly all of the states of Mexico, the tropical Yucatan peninsula excepted. Its southern range extends into Guatamala. Members of the genus in southern and southwestern Texas are now classified as *T. mucronatum*.

For two reasons it is not found in extensive stands. Apparently it needs to have its roots in water to reproduce naturally and since it does not grow below 1,000 feet in elevation it is not found in the extensive coastal swamp areas like those in which its relative, the baldcypress, is abundant.

Typically it is found singly or in small groves near water or along old channels that still have high water tables. The seeds germinate under water or in wet soil.

The tree is locally considered as having some medicinal value, is rarely regarded as a timber species, and is seldom cut. In fact, large specimens are most appropriately treated as though they were, if not a tree of the gods, at least as a tree of the kings.

According to Martinez[1], the tree is not native to the Valley of Mexico, in which Mexico City lies. However, the Indians in preconquest times made numerous plantings in what were then villages surrounding the Aztec capital but which are now encompassed by the growing city.

Two Aztec kings planted beautiful parks, each with several hundred trees. These date back to the thirteenth and fourteenth centuries at least. Some of the trees are in rows, proof that they were planted. The surviving trees are giants, and to the forester present one of the most impressive sights in a country full of natural and historic wonders.

Travelers on the Pan American Highway can find a number of unusual trees along the route. The species may be noted occasionally along the watercourses in the vicinity of Monterrey, 132 miles beyond the border. About the first large tree, however, is at Zimapan some 500 miles farther on. A beautiful specimen about fifteen feet in diameter stands in a park in the center of town.

In Chapultetec Park in Mexico City there are about 500 such trees, many of them magnificent specimens. One that fell in the year 1914 had a ring count indicating it was planted in the year 1294. The largest tree in this park is El Sargento. This beautiful tree is thirteen feet in diameter and 130 feet tall. Across the park near the southeast corner of the lake is a twelve-foot specimen. Pathways, named the Avenida de los Filosofos and the Avenida de los Poetas are lined with giants. The tree lover cannot help but be inspired by wonder and awe in contemplating that for over six centuries the park with its tree-lined footpaths has existed and that he is probably viewing the oldest forest plantation in the western hemisphere. As stated above, there are beautiful specimen trees in the one-time Aztec villages now within the city limits.

The tree of the sad night (El Arbol de la Noche Triste) is in Popotla. This marks the route of Cortez's retreat after being defeated by the Aztec forces in Mexico City. Unconfirmed legends indicate he sat beneath this tree on July 1, 1520, and shed tears as the remnants of his Army passed in defeat. The tree is gnarled,

[1]Martinez, Maximino. El Ahuehuete (Taxodium mucronatum Ten.) 82 pp., Instituto de Biologia Mexico, 1950.

grizzled, decayed, and suffers from being severely burned in 1872 when a nearby resident attempted to dispose of it because of the excessive shade on his house. The tree is sixteen feet in diameter, not including rather tremendous burls, such as are often borne by California redwoods.

In Atzcapozalco there is a square known as the Parque de los Ahuehuetes. Here are three large trees eight to eleven feet in diameter. In the square in Tacuba is a photogenic specimen twelve feet in diameter.

Twenty-five miles east of Mexico City near the town of Texcoco is the famous garden of King Netzahualcoyotl. According to authors of colonial times, King Howling Coyote was supposed to have lived from about 1400 to 1472, joining his fathers 47 years before the Spaniards arrived. He laid out his garden in a rectangle almost exactly ¼ by ½ mile and in cardinal directions. He planted over two thousand ahuehuetes on its border. About 275 trees still exist after 500 years. The largest is 11 feet in diameter and they not only outline but almost fence much of the original garden. These trees are fairly healthy, beautiful individually, and collectively in their long, straight lines are most inspiring. Again one is thrilled to contemplate their history.

World famous is the Tule Tree (see front cover) in the valley of Oaxaca, 340 miles south of Mexico City. Reputed to have the largest diameter of any tree in the world, this majestic specimen stands beside the Pan American Highway seven miles east of the city of Oaxaca. According to Conzatti[2], the tree is an even thirty-six feet measured as with a diameter tape one meter above the ground. Due to its irregular circumference and some rather prominent fluting, the basal area is only 640 square feet, somewhat less than some of the giant Sequoias. The greatest diameter of the tree is an even forty feet, which is probably the world record along with that of its d.b.h. as usually measured. The height of the tree is about 130 feet, about as high as any specimen on record. It sits in the churchyard in the village of Santa Maria del Tule. This name would indicate the place was once a cat-tail marsh and a suitable place for the natural regeneration of the species. Nearby are two large trees, El Hijo (The Son) and El Nieto (The Grandson). In the town of Oaxaca is El Marquesado. All of these trees are near sixteen feet in diameter and would be near-record specimens but for the giant El Tule.

It is difficult for a North American to visualize that such advanced ideas towards trees and gardens existed on the continent long before European conquest. However, a look at history and the development of their civilization as of 1519, the year the Spaniards arrived, reveals some startling facts about the Aztecs. They were far advanced in astronomy and used a calendar more accurate than even ours of today. Their republican politicaI organization was complex, including such modern concepts as price controls and established units of weights. Montezuma maintained a large zoo. Their civilization was mainly agricultural and, while they had not developed the wheel or the arch, they had a well developed architecture and expended tremendous effort in the construction and embellishment of temples and pyramids. These could well be classed with the wonders of the world. One can understand that gardens and trees became a part of the scene when their civilization developed to a point where there was surplus effort for architectural beauty.

All of these are of interest to the visitor but none will enthuse the forester more than the magnificent specimens of El Sabino, the National Tree of Mexico.

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[2]Conzatti, Casiano. Mongrafia del Arbol de Sta. Maria del Tule. Secretaria de Educacion Publica Mexico, 1921.

Cutting Mine Timber Profitably

The Forestry Division of the Conservation Commission of West Virginia and the Appalachian Hardwood Manufacturers, Inc., have recently cooperated in a survey of West Virginia's mine timber operations. Findings and recommendations from the survey are condensed herein.

The deep mines of West Virginia, which annually produce some 122 million tons of coal, require roughly 250 million board feet of sawed timbers per year. These timbers are valued at $11 million delivered at the mines and require approximately 438,000 man days of labor or a year's work for 2,200 men. Some 50,000 acres of forest land are the source of supply.

The survey sought to determine four things about mill operations: (1) the chief causes of lost production time; (2) the effect of log sizes on production rate; (3) whether high grade logs were being cut into low grade products; and (4) whether manpower and mill equipment were in proper balance to maintain good production. It sought also to determine what effect logging operations were having upon profitable operations of the mills, and included recommendations for remedial measures.

Operations were studied at 26 mine timber producing mills scattered throughout the state. Results indicated that at the average mill 32 percent of total production time was lost, or in other words that operators were losing about one-third of their profits to inefficiency.

The survey revealed that four items accounted for 27 percent of total production time and were essentially avoidable (Table 1). These were: (1) lack of logs, (2) faulty equipment, (3) time consumed in filing saws, and (4) time consumed in moving slabs, logs, and lumber. Another 5 percent of production time was taken up by fueling, oiling, and by crew members talking, resting, and getting water. These latter items were judged largely unavoidable consumers of time,

TABLE 1.—DISTRIBUTION OF LOST OPERATING TIME OF SAMPLE MILLS CUTTING MINE TIMBERS IN WEST VIRGINIA

	Percent of total time
Lost time—Unavoidable (Fueling, oiling, rest periods, etc.)	4.0
Avoidable	
Lack of logs	6.0
Faulty equipment	6.5
Filing saws	7.0
Moving logs, lumber, etc.	7.5
Miscellaneous small items	1.0
Sub-total	32.0

though they were subject to some degree of correction, perhaps to the extent of one-fifth of their total time.

Of the total time lost, almost one-fifth (6 percent) was found to be due to lack of logs for sawing, which at times idled entire sawing crews. This loss was attributed entirely to poor logging methods rather than to poor sawing operations. Three remedial measures were recommended. Since cutting crews could produce more volume when larger trees were cut, a minimum diameter of 12 inches for trees to be cut was suggested. One-man power saws were recommended in woods operations, as one man with a power saw can cut as much as two men with a cross-cut. Lastly, it was recommended that logging be done in tree lengths wherever possible, especially in small timber.

One-fifth (6½ percent) of the total lost time was found to be due to faulty equipment, such as worn carriage and husk parts and unfloored log decks. Repair or replacement were the obvious requirements. Wear of mill parts could be reduced by realignment of carriage and husk according to factory specifications. Time could be saved when logs were being rolled onto the carriage or turned by reinforcing the foundation of mill floors, thus reducing "give and take" of the floors. A one and one-half to two inch floor of oak or locust was recommended on the log deck.

Slightly more than one-fifth (7 percent) of the time lost resulted from shutting the mill down while saws were being filed. The remedy suggested for this was the use of two headsaws. The saws could be changed in five minutes as compared to the 20 or 30 minutes required to file a saw. The sawyer can be given extra pay to file saws outside of operating hours. Experienced operators also believe that a log pond or pumper unit is justified for any saw-set which will produce 1,000 M bd. ft. or more, as the washing of logs is a big item in cutting down on saw wear.

The biggest time consumer of the lost time items was stoppage of the mill to move logs, lumber, and slabs. This accounted for 7½ percent out of the total of 32 percent lost time. In most cases the addition of a few simple, homemade devices offers a solution. A small, fast log turner should be added, especially where the mill crew does not include a tail sawyer. A good dock and lumber truck and adequate lumber rollers are needed. A slab conveyor will save about four man hours of labor each day and can be constructed for less than a $200 cash outlay. A skidway drop of one inch in 10 feet toward the carriage was recommended in the report of the survey as was a sawn or cut top surface for skidway poles.

About one-sixth of the lost time (5 percent of total production time) was found by the survey to consist of small, miscellaneous items that could be remedied to some extent, but not entirely. For instance, the time lost when workers are given breaks in mid-morning or mid-afternoon is considered time well spent in keeping up morale. Furthermore, men get careless when tired or their work becomes monotonous. On the other hand, some small items can be remedied, as in the frequent instance where the cut-off man gets behind when a number of cribbing cuts or other short items come through in succession. This can be corrected by having the tail sawyer assist the cut-off man for short periods.

A number of things were revealed at the 26 mills included in the survey that, while they actually have little to do with the time lost, may be well to consider from a money return point of view. Of these, two primary ones stand out. First, almost any mill cutting mine timbers will accumulate a truck load of high grade lumber each month, and several mills will produce a carload. This lumber should not go into braddice or low grade construction. It will bring nearly double the price paid for such material when green and even higher prices when air dried. Secondly, mills which cut any appreciable amount of lumber should have an edger. This will not only increase the production but also the quality of lumber cut. At mills producing primarily mine timbers, however, a slab conveyor is probably a more necessary and more profitable investment.

A proper balance of manpower and equipment is essential in order to cut timbers or lumber at the highest possible profits. Manpower requirements for small mills include two men for the headsaw and one additional man for each additional piece of equipment, such as edger, deck, cutoff, and lumber cart.

In summary, the most profitable production of sawn timbers requires (1) not over one hour lost time daily, (2) cutting only logs from trees 12 inches in diameter or larger, (3) sorting out all grade lumber and selling to the best market, and (4) proper balance of manpower and equipment.

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The Norwegian Screw Splitter for Fuelwood[1]

Norway uses large quantities of wood for residential heating during the long winter months. Coke and anthracite are expensive and often difficult to obtain. Oil is frequently used for heating in the larger cities, but may not be obtainable in the outlying districts. Electricity is cheap and often used for heating, but because of limitations on rate of use—and sometimes on total use, as during the period of rationing following the dry summer of 1955—supplementary heating usually is provided with stoves that burn solid fuels.

[1]This paper was prepared while the author was a Fulbright scholar at Norwegian Technical Institute, Oslo. Photos were provided by Jo-Bu Salgkontor A/S, Oslo.

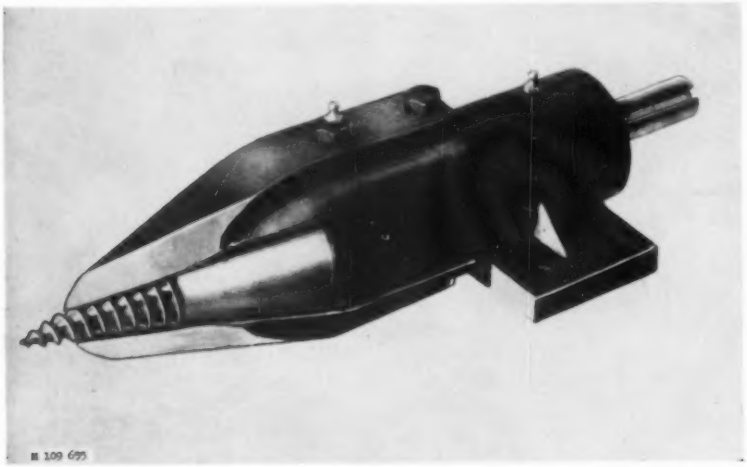

FIG. 1.—The operating head, with (replaceable) screw point and with splitting wedges above and below the steeply tapered screw.
Photo courtesy Jo-Bu Salgkontor A/S, Oslo, Norway

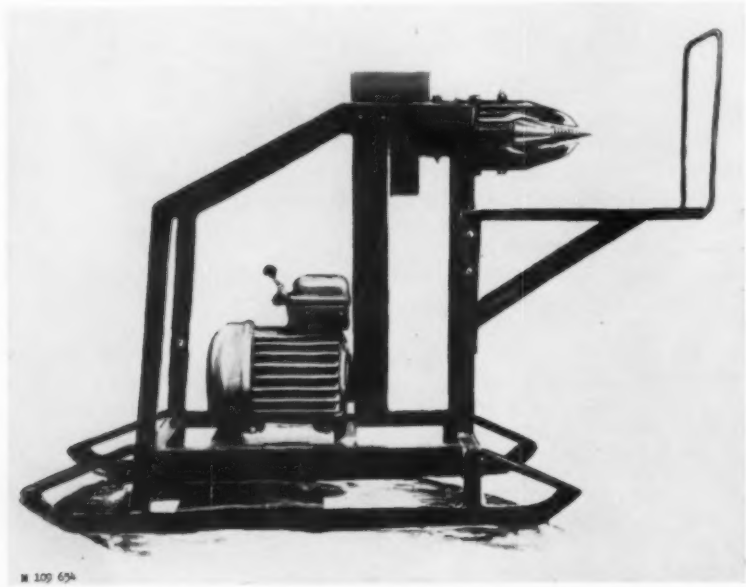

FIG. 2.—The complete assembly—a stand on runners, motor, splitting head, and adjustable table.

The thermally efficient Norwegian stoves are usually tall and slender, with fireboxes that are deep but small in cross section. These dimensions interpose no obstacles when coke or coal is used, but wood must be cut small enough to pass through the firing door and form a satisfactory fuel bed. Common lengths of stovewood are 6, 8, and 12 inches, thicknesses and widths up to 5 inches.

Even though Norwegian trees are rather small in comparison with American trees, fuelwood requires much cutting and splitting. Roundwood is first cut to length, of course, which results in a multitude of blocks to be split before the wood is suitable for fuel use. The axe and the power-driven wedge-type splitter are too slow and somewhat hazardous.

To meet the need for efficient splitting of wood of various lengths, a new type of splitter was placed on the market about 5 years ago. This patented "Skru Kloyvern," or screw splitter, is made in various assemblies ranging in price from approximately $50 to $93, exclusive of motor. The simplest assembly is the operating head alone (Fig. 1); the complete assembly consists of a stand on runners, the operating head, and a belt drive, flywheel,

FIG. 3.—The "Skru Kloyvern" in action on a birch stick about 8 inches in diameter.

motor mount, and vertically adjustable table (Fig. 2).

The splitter is simple to operate. The sticks to be split are up-ended on the table and touched against the point of a revolving, steeply tapered screw that is flanked above and below by wedge-shaped splitting knives. The screw starts easily in either bark or wood and, once started, draws the piece ahead. The steep taper of the screw, in combination with the splitting knives, develops the splitting force. The splitting knives also prevent the stick from turning on the revolving screw. Each stick may be split into as many pieces as necessary to reduce it to usable size. Figure 3 shows the machine in the process of splitting a birch stick about 8 inches in diameter.

The screw splitter operates best with the harder woods and will split hardwoods up to 14 inches in diameter. This maximum decreases somewhat as length increases. Softer woods develop less screw-holding power; for pine and spruce, the maximum diameter is about 9 inches. The screw will not hold in rotten wood, but if an outer shell of solid wood is present, center rot does not interfere too much.

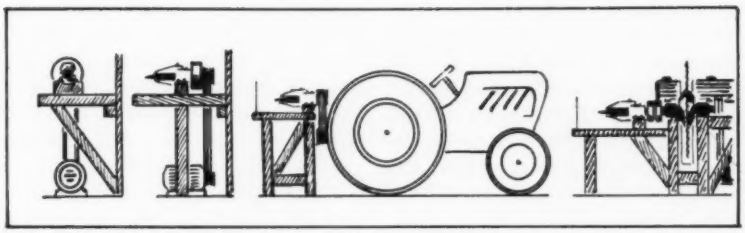

FIG. 4.—Suggested methods for mounting and power application.

The splitting screw, with a 55-pound flywheel, is revolved at 2,000 revolutions per minute by a motor of 3½ to 5 horsepower by means of a flat belt or up to four Vee belts. The flywheel is useful with a motor of low power when large pieces are split. A power take-off from a tractor or truck can be used, or the splitter can be powered by the cut-off saw motor. Many mounting variations are possible, and a portable unit consisting of a cut-off saw, a conveyor, and two splitters has been readied for the market. Suggestions for homemade mountings are shown in Figure 4.

The screw thread is designed for maximum holding power. Screw points are replaceable at a cost of about $12.

With the screw splitter, one Norwegian operator put up his winter's supply of wood in about one-third the time required with a power cut-off saw and splitting axe, and with much less labor. A winter-long operation with pine, using two screw splitters, a power cut-off saw, and a 5-man crew, showed an average production of 14.8 cords per crew-day, including the breaking-down into 24-inch lengths.

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[2]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Commentary Review of "The Status of Forest Industries in U.S.S.R."[1]

"Det skogsindustriella laget inom Sovjetunionen" by K. V. Algvere (143 pp. Swedish Wood Exporters Association. Stockholm. 1955.) is a report on Russian timber resources and logging organization made on request from the Swedish Wood Exporters Association. It is issued with limited distribution only.

The report is a compilation based on Russian papers, magazines, and other publications obtained in Russia, Germany, and the United States covering a 50-year period of time. The objective of the summary was to obtain a picture of timber resources and logging techniques in various regions of the U.S.S.R. Since the forest types are quite different in various regions, the author has treated each region separately. The report is for that reason necessarily repetitious but nevertheless is interesting and rich in details.

The most prominent features of the Russian exploitation of virgin timber are the great distances and the transportation problems arising from the limited usefulness of the rivers that flow to the Arctic Ocean. In the spring, the rivers thaw out first in the southern, upper tributaries while remaining frozen down stream in the North. They cannot, consequently, be used with the same advantage as the Swedish rivers, which thaw out at the mouth first. Great flood problems occur in the Russian rivers, particularly where tributaries join the main river.

Past mistakes in the location of sawmills and pulp plants are causing additional problems of supply. The previous five-year plans appear to have been gigantic failures as far as forest industries are concerned. Due to lack of commodities, there is also a continuous shortage of skilled labor. The severe climate and the low output by uninterested or forced labor limits the production. Many of the old forest industries are now abandoned because of exhausted timber resources, and a great number of new sawmills and pulp plants are scheduled to be built according to the current five-year plan. Since only a minor portion

[1]Authorized through the courtesy of Knut Ronge, general manager, Swedish Wood Exporters Association, Stockholm.

of personnel and labor is skilled, and the key personnel, because of the state structure, must be reliable from a political point of view, planning and efficiency leave much to be desired. Certainly, there are great difficulties to overcome, but the report gives a good picture of many weaknesses.

The photos are quite interesting, since they give a good idea of the type of equipment used in the logging operations. Electrically powered tools and cranes are used generally. Tractors are rebuilt especially to haul whole trees into central landings, and the logging trucks seem to be converted lend-lease material, partly powered by charcoal burners.

Although the timber resources are depleted over large areas around the old forest industries, extensive areas of virgin timber still remain in European Russia as well as in Siberia. The most important species are pine, spruce, fir, and larch. New railroads are being built and the canals are used for transportation of log rafts. Plans are initiated to build huge dams in the Siberian rivers in order to flood vast areas in the interior of Siberia. This is calculated to improve the climate by raising the humidity, and to increase the farming opportunities by irrigation. As a result, the authorities hope to establish new forest industries. All in all, this project is quite impressive. It would lead to the creation of an entirely new industrial region the development of which, however, seems to demand labor and personnel to an enormous extent. The uncertainties of open routes for shipping through the Arctic Ocean makes the exploitation of northern and central parts of Siberia a slow process. The logging of virgin timber started along the Trans-Siberian Railway which is the main means of transportation. Many of the sawmills are for that reason located at railway crossings over the major rivers. The timber is hauled upstream from points located north of the railway. Logging has now extended so far from the railway and the sawmills that plans have been made to relocate sawmills in areas with virgin timber. The volume of timber per acre in the new areas is, in many cases, too low to justify anything but cheap labor and light investments.

To compose all impressions from various regions into a general picture, based on a look behind the "Iron Curtain," the following may be said: Sawmilling is the backbone of the Russian wood industry. Since half of the sawmills are located in areas with poor or no timber resources, great transportation problems occur. The sawmills that were destroyed during the war have not been rebuilt, but new sawmills are being erected in the northern and eastern forest regions. The new five-year plan (1951-1955) which aimed at raising the lumber production 50 percent over the previous plan, has been a great failure. For 1951, the construction quota was fulfilled only to 65 percent and in 1952, only to 44 percent. The split administration is an essential cause of the lagging development of the sawmill industry. The sawmills are distributed among various state and cooperative enterprises without any common planning. Besides the ministry of forest industries, the ministries of construction, metal industry, mining, and oil also have their own sawmills. In European Russia, 35 percent of the timber logged by the ministry of the forest industries must be delivered to the other ministries even though many of their own sawmills are idle due to lack of timber supply.

The pulp and paper industry expanded particularly during the 30's and additionally, as a result of territorial gains during the last war. The total number of pulp and paper plants is probably over 200, many with a total annual production exceeding 100,000 tons. The plywood and matchwood industries are concentrated in a few large plants. Recently a number of new plywood plants have been erected in remote areas of good timber supply in northern and eastern parts of the U.S.S.R. The pulp and paper industry, as well as the plywood and matchwood industry, is managed by the ministry of paper and wood manufacturing.

Logging operations, like sawmilling, are managed not only by the ministry of forest industries but also by other ministries and state enterprises. Half of the total cut in U.S.S.R. is logged by operators which do not belong to the ministry of forest industries but to machine plants, mines, railways, etc. The mechanization of logging operations started after the war and in regulations of 1953 it was decreed that by 1955 the felling should be mechanized to 100 percent and the transportation to 90 percent. The achievements, however, are far short of this goal. The inability of the management to organize work efficiently and the lack of interest in keeping informed on technical developments are two factors that have caused poor direction of logging operations and a lag of production. New machines are not effectively utilized. The maintenance of equipment is poor and a great number of machine units are daily out of production. Work shops are poorly organized and the mechanics are unskilled.

Electricity is used to a great extent. Felling is done with electric power saws and yarding with either high lead or tractor. Loading utilizes cranes or crawler tractors with cranes. Logging trucks and often tractors are driven with charcoal gas. Narrow gauge railways are still in conspicuous use.

Loggers are unwilling to learn about machines or to acquire technical knowledge. Laborers, and also technical personnel, move because of various adverse conditions to other places where they can get better living conditions. Hospital care and living quarters are deficient and the food supply in remote areas is erratic. The logging labor is composed of three categories: seasonal, permanent, and forced. In the more remote areas, the labor is mostly prisoners and forced labor. Women are a component of the labor.

It is amazing to find that Russia,

despite her enormous timber resources, has difficulties in supplying the domestic market. This is mainly due to the long distances between centers of consumption and the forested regions. Two-thirds of the timber and lumber is shipped on the canals. Although the rivers and canals are the most important means of transportation, there is only the river Volga that can be used for the transport of timber to southern Russia. Since most of the other rivers flow into the Arctic Ocean, the timber is first driven from the forested areas to ice-free ports, where many of the sawmills are located. It is then shipped by railway or by boat on sea routes, back to centers of consumption or to foreign ports. Shipping by boat on sea routes is limited in the Siberian part of the Arctic Ocean.

Russia's role on the export market has been determined by two factors: Its need for foreign currency to import machine equipment, and its domestic demands. Between the World Wars, the first factor was predominant, whereas after World War II, domestic needs have been given priority. However, the export has increased gradually and shows a rising trend. Statements in Russian newspapers and magazines indicate that export will continue to increase considerably.

The comprehensive and well illustrated report by Mr. K. V. Algvere on assignment from the Swedish Wood Exporters Association is a very interesting study. It is an attempt to look behind the curtains of official planning and to analyze the prospective competition of Russia on the export market. Although the Russian timber resources are enormous, the Russian export volume probably will be restricted for some time to come due to growing transportation problems and increased domestic demands. The Russian timber prices will be quite competitive, since the labor costs are low, and since the quality of timber is very high. In view of the alliance between Russia and satellite countries, due consideration must be given to the fact that China in particular, but also most of the satellite countries, are wood importing. These countries behind the Iron Curtain can import low-priced Russian lumber which will restrict seriously their import of wood from countries of the Western World not under the influence of U.S.S.R.

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A Regression Equation Relating Diameter Growth Rate of Jack Pine to Live Crown Percent

A study in dense 26-year-old jack pine in central Wisconsin on a low medium site (site index 42 at 50 years) on outwash sand revealed a striking correlation of diameter growth rate with the percent of the total height of the tree in the living crown. The relationship, based on data from 174 trees in a noncommercial thinning experiment, is shown in Figure 1.

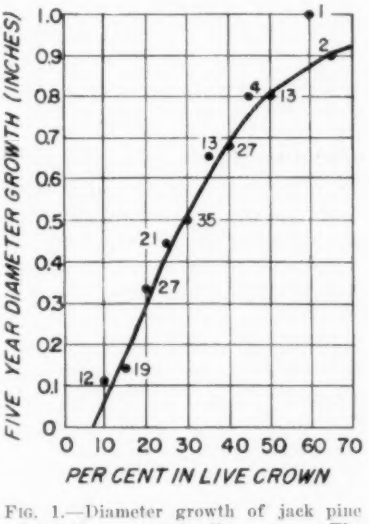

FIG. 1.—Diameter growth of jack pine related to percent in live crown. The equation for the curve is: $y = -.2030 + .0301x - .0002x^2$. The correlation coefficient ($r = 0.836$) is significant at the 1 percent level.

The curved value for trees with only 10 percent of their total height in live crown was 0.07 inch diameter growth in five years; at 20 percent it was 0.30 inch; at 30 percent, 0.52 inch; and at 40 percent, 0.68 inch. The majority of the data came from trees in the unthinned areas. Data from trees in the thinned areas generally had deeper crowns, developed in response to thinning.

A second series of data, derived from an independent study in 35-year-old jack pine near Spooner in northwestern Wisconsin, with site index 48 at age 50, was found to fit almost precisely on the curve as shown.

Obviously, the percent of tree height in the live crown is a rather good index of the total amount of needle area of the crown, and of the ability of the tree to convert solar energy, moisture, and nutrients into cellulose.

These observations have been useful as a guide in the thinning of young stands which were tending to stagnate in diameter growth. The reasonably deep-crowned trees, which, incidentally, are also sturdier and less subject to snow bending or breakage, are left as residuals, and the weak-crowned spindly trees are removed.

J. H. STOECKELER and L. P. OLSEN
Respectively, research forester and statistician, Lake States Forest Experiment Station[1]

[1]Maintained by the Forest Service, U. S. Department of Agriculture, at St. Paul 1, Minnesota, in cooperation with the University of Minnesota.

Points of View

Further Comments on the Relationship of Forestry and Land Surveying

It was with a great deal of pleasure that I read the article by Jack W. Coskey in the March JOURNAL entitled "Comments on Relationship of Forestry and Land Surveying."[1] I feel his article is very timely and I most certainly concur with Mr. Coskey that forestry as a profession should in no way infringe upon the land surveying profession.

After working in industry here in the Pacific Northwest for three years as a professional forester I took the state examination and acquired my license as a professional land surveyor. At present I am employed by a consulting engineering firm doing land surveying.

Land surveying is a highly skilled profession and the average forester hasn't the necessary training or experience to prepare him to properly execute this work. If foresters find that surveying is necessary, they should prepare themselves and obtain a license by examination.

Some foresters feel that a mediocre preformance in a boundary survey is entirely adequate. Since they have no fixed responsibility, this is understandable. Any person not liable for the work he is performing is not going to be as thorough as the person who holds an unrevoked certificate of registration and is subject to the action of the governing state board. It is my feeling that we should leave the practice of land surveying up to competent licensed land surveyors and not attempt to do it as foresters.

WILFRED L. WEBB
Seattle, Washington

[1]Coskey, Jack W. Comments on relationship of forestry and land surveying. Jour. Forestry 55: 218. 1957.

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I have been extremely interested in the comments on the relationship of forestry and land surveying, both in the report[1] of the Committee of your Society on the registration and licensing of Foresters, and in the letters commenting on this report.

As a consulting forester and licensed land surveyor here in Nova Scotia, I have had experience with a system of registration of surveyors similar to that recommended by your Committee, and which appears to be opposite to that in existance in Maryland, according to Mr. J. F. Davis' letter in the March issue of the JOURNAL. Here, the Land Surveyor's Act is administered under the Provincial Department of Lands and Forests —of which the Deputy Minister and Chief Forester are foresters and also land surveyors. It is possible here for a forester or engineer to obtain a surveyor's license by completing a few months of apprenticeship and writing an examination in surveying law (this examination customarily consists of questions in writing and interpreting property descriptions).

There are, however, certain unfortunate aspects to this situation which should be considered and which I have listed as follows:

1. The surveyor's training is not adequate in certain respects. The university courses in surveying given to foresters and engineers, while excellent as far as surveys for construction work are concerned, are short on the vital subjects of laws concerning title to land, the law regarding boundary location, and especially the laws of evidence. The last is extremely important, because the surveyor, like a police officer investigating a crime, is charged with the responsibility of gathering evidence; and when he establishes a boundary he should be sure that it is upon evidence which will "hold water" in court, if necessary. The various periods of apprenticeship required in most places for a surveyor's license are supposed to remedy this deficiency in training. This system doubtless works out well enough in some cases, but is at best a time consuming way of learning what might better be taught in a classroom by a qualified lawyer.

In the older states and provinces in North America timber stumpage and forest land are relatively valuable because of ease of accessability and adjacent markets. As the condition of land titles and boundary locations in the said areas can only be described as chaotic, in most cases, it is possible for poorly trained surveyors to make really costly errors in forest land.

2. Here in Nova Scotia we have a plague of "Sunday Surveyors" —foresters and engineers who have surveyor's licenses and who, although they have steady jobs, do private surveying in their spare time—thus injuring the business of those in private practice, and often giving the public unsatisfactory service. Some charge cut-rate prices and do cut-rate jobs. Almost all refuse to stand behind their work for fear of trouble with their employers if they are involved in a court case. This sort of competition makes things very

[1]Report of the committee on the registration and licensing of foresters. Jour. Forestry 55: 45. 1957.

difficult for the surveyor in private practice.

Many of these difficulties, in Nova Scotia and elsewhere, could perhaps be solved by the following measures:

(a) Making college training for foresters in boundary surveying a good deal more comprehensive than it is at present.

(b) Cooperating with the local professional society of land surveyors and the local licensing board to make it possible for these better trained foresters to get surveyor's licenses without writing exams in subjects which they have passed in University, and without having to complete unduly long apprenticeships.

(c) Changing licensing regulations so that the license of permanently employed surveyors would be valid only for work performed in connection with their regular jobs, thus giving the surveyor in private practice a fair chance to make a living.

EDMUND S. TELFER
Caledonia, Queens County, Nova Scotia

The Lesson of Hearts Content

Today the grandeur of the primeval forest preserved "forever" in the 6,799-acre state park at Hearts Content, Pennsylvania is no more. A violent windstorm on August 18th, 1956 tore through this stand of great pines and hemlocks, uprooting, breaking off, and piling them in a tangled mass of debris. (*American Forests*, February, 1957, pp. 20-21, 61.)

The state legislature in creating this reservation had wisely provided by law that the Department of Forests and Waters should have the authority to make sanitary cuttings to protect the health and vigor of the stand and thus prolong its life. But after a short period of operation of the sawmill, the sentiment which always manifests itself arose in opposition to any cutting whatever. Natural areas must be left entirely to the free play of natural forces! The opposition became virulent enough to force the state to transfer the local ranger, who then resigned, and to terminate all cutting.

Then nature took a hand and with savage violence levelled a swath through the forest which left a mere remnant of the old timber standing.

Now comes the significant point. True to principle, the advocates of "natural areas" *came out strongly* for a "nature trail" through this blowdown, leaving the rest of the windfall on the ground, "preserved for posterity." Said the author of this article, Don Neal, "it was the thought of the backers of this movement that if future generations were not to see the great trees standing in their glory, they could at least see them lying in their defilement. This too was a good thought, but it was the same kind of thinking that had, in an indirect way, brought about the devastation by allowing time and age to prepare this 'Kingdom of the Pines' for the ravages wrought on it by the wind fury of August 18th."

The author then recounts the plans of ten years previous, for improvement cuttings and their demolition by the advocates of the inviolability of natural areas.

This time the drive for keeping "hands off" of the wrecked forest was met head on by the trained foresters of the Department, who emphasized the danger to the remaining stand of insect attacks spreading from the fallen timber, and the seriousness of the forest fire hazard, so great that even the safety of tourists might be endangered.

Secretary M. K. Goddard of the Department of Forests and Waters decided that a complete and thorough cleanup of the area was required, with the intention of completing the work by June, 1957. A million board feet of timber is the estimate of the volume to be cut. It is believed by these technicians that had the original policy of sanitation been continued, the damage to the stand might have been considerably reduced. As it is, good common sense has prevailed over the urge to let nature take its course and allow the trunks to rot as they lay. The question which this experience at Hearts Content raises is this: Should we entrust the care and protection of our park reservations to technically trained men, fully embued with the desire to take every means to prolong the life of the stands for their primary purpose of beauty; or turn over their "management" to enthusiasts without training or knowledge, whose sole actuating motives are to keep hands off, stand aside, and "observe" the results?

H. H. CHAPMAN
New Haven, Connecticut

Reviews

America's Natural Resources

Edited by Charles H. Callison for the Natural Resources Council of America. 211 pp. The Ronald Press Co., New York. 1957. $3.75.

"One of the most noticeable phenomena in the past twenty years has been the growing understanding that it is impossible to develop one segment of renewable natural resources without impinging directly or indirectly upon others."

This quoted statement from the last chapter of *America's Natural Resources* expresses the primary value of this book and the reason behind its creation. Introductory and final chapters give a broad perspective to conservation problems, while other chapters deal with the following subjects: resources and human needs, population, soils, water, grasslands, forests, wildlife, fish, parks and wilderness, and land use principles and needs. For each topic, authors have sketched historical background and present situation, shown dangers, and pointed out methods by which the resources may be preserved and used most profitably in the long run. In each case, also, the interdependency of resources, the relationship of each to the others, is stressed.

The result is a book that serves the very useful functions of (1) supplying serious student and intelligent layman with basic information for the understanding of resource problems and (2) presenting for scientist and nonscientist alike, a coordinated view of the whole renewable resource picture. This is a view that we perhaps are currently able to comprehend only in part. It represents, however, the only approach that will lead to solution of the problems of resources and human needs.

Chapter authors are recognized authorities in their fields. Chapters are handled with helpful uniformity of approach but still with sufficient individuality to make good reading and to permit handling each subject most appropriately. "Forests," for example, was written by Henry Clepper, Society of American Foresters, and Lowell Besley, past executive director of the American Forestry Association and now with the Pulp and Paper Research Institute of Canada. Forests of the United States are described by natural regions and discussed for their services and products. The history of forest development and of forestry is covered, after which present concepts and activities are described. The chapter closes with a summarized program for American forestry.

Beside Clepper and Besley, the book's authors include three other names well known to readers of the JOURNAL—Shirley W. Allen, Harold G. Wilm, and David F. Costello, whose chapters are entitled respectively, "Conservation: An Ecological Approach," "Water," and "Grasslands."

The Natural Resources Council of America, sponsor of the book, is a non-profit, non-political affiliation of forty national and regional associations interested in conservation. The editorial committee, headed by Callison, also included Henry Clepper, Michael Hudoba, Washington editor of *Sports Afield*, and Richard W. Westwood, editor of *Nature Magazine*.

The book supplies a real need—an objective, factual, reliable discussion in non-scientific terms of the nature and status of our resources and the problems involved in their management, together with methods by which solutions to those problems may be sought.

A realization of the nature and availability of this book should result in its being used in schools and colleges. Immediate value to the work of resource conservation can be envisioned with the happy thought that perhaps somehow it will find its way into the hands of the nation's legislators and economic and social leaders.

ARTHUR B. MEYER

Economics of Plantations

By W. E. Hiley. 216 pp. Illus. Faber & Faber, Ltd., London. 1956. 25s

This little book, addressed to the practicing forester rather than the economist, might be described as a short course in applied forest finance. Its scope in Hiley's own words is "how to make plantations as profitable as possible." The analysis is set in a British framework and deals exclusively with growing trees in plantations. But we too are planting trees and the expression of volumes in hoppus feet and values in pounds does not obscure the applicability to American conditions. Hiley's years of experience in managing Dartington Woodlands, Ltd. are reflected in the down-to-earth expression of his ideas, but the easy, conversational tone never completely camouflages the competent economist.

The book begins with a discussion of interest on capital. Hiley recognizes two interest rates: the *financial yield*, or rate actually earned on the fluctuating amount

of capital invested in the plantation and the *fixed rate* at which money can be borrowed for investment in forestry. He suggests using the fixed rate in decisions involving additional investment and the financial yield in deciding between treatments which do not require additional capital. But he claims the forester's job is to maximize financial yield, in which case the interest rate is the dependent rather than an independent variable. And he recognizes that money may be invested in forestry even when the possible financial yield is lower than the fixed rate if a nation desires to insure against a timber famine or to conserve water. Despite Hiley's efforts, compound interest still remains a most unsatisfactory feature of the economic theory of forestry.

He then devotes a chapter to the Faustmann formula, which we know as the soil expectation value formula. (The first time this formula appears on page 49 the denominator is shown by mistake as $1.0p^{r}$-1 instead of $1.0p^{r}$-1.) Hiley uses the Faustmann formula to derive land values, financial yields, and per unit costs of growing timber. He shows how to determine the financial yield by graphing land expectation values over various interest rates as he did in his earlier *Economics of Forestry* and reprints the Tables of Multipliers from that book.

A long chapter on "The Economics of Thinning" is the real heart of the book. Hiley feels that thinning is the key to the financial success of a plantation. His main thesis is that heavy thinnings are necessary to maximize financial yield. The British Tables allow for thinnings which are very heavy by German standards but too light to suit Hiley. (The book includes a number of biting comments on the "antiquated" German methods.) In support of his thesis, Hiley presents calculated results for various thinning grades. Assuming that the grade of thinning will not materially affect the current annual increment, he builds up new yield tables by calculating the dimensions which the 100 largest trees per acre might attain at successive ages if the stand were thinned to maintain a uniform ring width. On the basis of these tables Hiley claims that heavy thinning might increase net annual profit by 29 percent, increase financial yield by 0.5 percent compound interest, and reduce production cost per unit by 44 percent from the results indicated by the moderate thinnings in the British Yield Tables. Though he may be enthusiastic about the possibilities, he makes a strong case for further investigation of thinning grades which should interest industrial foresters in this country.

The remainder of the book discusses rotations, what can be spend on land improvement, and similar problems of immediate concern. Many of Hiley's conclusions are speculative, for in Britain, as here, adequate cost and return data are still lacking. But I feel he has achieved his object of "presenting a limited branch of forest economics as a live, pulsating subject instead of an academic collection of formulae."

ALBERT C. WORRELL
Yale University

Christmas Trees for Pleasure and Profit

By Arthur G. Chapman and Robert D. Wray. 215 pp. Illus. Rutgers University Press, New Brunswick, N. J. 1957. $3.75.

This is a complete handbook for the Christmas tree grower. It is written in a pleasing, non-technical style, is easy to read and understand, yet is technically sound throughout. It is illustrated with many excellent photographs by the senior author, with a number of contributed pictures and several sketches and line drawings. Though written primarily for farmers, commercial Christmas tree growers, hobbyists, and the like, this book could serve nicely as a text or reference in vocational agriculture or general conservation courses as well as for Boy Scouts, 4-H Clubs, and other conservation groups interested in planting and growing trees.

The book discusses both the scientific and business phases of growing Christmas trees. The stimulating first chapter with its catchy title, "A *Growing* Business," creates an interest which continues throughout the whole 20 chapters. However, with a word of caution, the authors point out that "Many things must be done before a tree can even be put into the ground."

More than one-third of the text is devoted to the important phases of preliminary planning and preparation. These chapters include "Selecting Land," "Species to Grow," "Where to Get Trees," "Choosing the Planting Stock," "Preparing the Ground," "When to Plant Trees," "Care and Handling of Planting Stock," "Planning and Managing the Plantation," and "Spacing of Trees."

After all the preliminary planning, upon which the success or failure of the business largely depends, a substantial chapter of 17 pages describes, in detail, "The Planting Job." Here, planting with both the planting bar and the mattock are thoroughly discussed and illustrated by sketches. The many "dos, don'ts, and how-tos" of the planting business are mentioned. Planting by machine is touched on briefly and a mechanical planter is illustrated.

"Keeping Plantations Clean" is a chapter devoted to the necessary maintenance jobs. Cultivation, mowing of grass, and the methods used for killing hardwood brush with herbicides are described and illustrated.

Shearing, which is a comparatively recent development, is described and illustrated. An investment of 1½ to 2½ cents per tree per year for three or four years, starting when the trees are about two feet high, greatly increases the value of the trees, especially if they are pines. The authors state that "No grower can afford *not* to shear his trees."

"Protecting the Plantation" is an important chapter to which 19 pages are devoted.

Three chapters are devoted to grading, harvesting, and marketing the trees. While there is yet no standard grading system for Christmas trees, a table is presented to show suggested generalized grading standards dealing with form, density, and foliage characteristics.

Under "Profits—and Taxes," the authors show how to compute income taxes under both the old cost-and-returns method as well as the new method, where part of the income can be reported as long-term gain.

In the final chapter are listed the various public and private organizations and associations through which additional information and assistance can be obtained. This is followed by a list of 30 suggested references.

With the exception of a discussion on the need, desirability, and availability of insurance against possible losses from fire and other damaging agents, this book is a complete guide for the Christmas tree grower.

G. LUTHER SCHNUR
Southern Forest Experiment Station

Wisconsin's Renewable Resources

By James A. Larsen. 160 pp. Illus. University of Wisconsin, Madison. 1956.

This book, contrary to what one might infer from the title, is actually a report on research done at the University of Wisconsin in the renewable resources of field, forest, lake, and stream. It covers soils and natural vegetation (both forest and prairie), game and fish resources, and water.

The book is organized into 27 short, well-written chapters, with a fairly equal allocation of space to the subjects above. Each chapter has a list of references, and the text is well illustrated with excellent photographs. The book is a model of good layout. The historical background material for certain chapters was, to this reader, the most interesting aspect of the book.

Some of the background material apparently was obtained by interview with specialists in their respective fields, and this probably accounts for good coverage of some subjects and somewhat lighter treatment for others. Sections dealing with upland game birds and fish and water research appear to be much more adequate as to balance and coverage than those dealing with natural vegetation, particularly forests, or with soil conservation. The collection of the facts on some of the individual game species make especially interesting reading. Judging by the extent of the reference lists, one assumes that most of the University of Wisconsin publications in this field are cited.

This could have served as a textbook for conservation teachers if coverage of the forestry and soil chapters had been broadened; a tabulation of the total acreage of forest and of individual forest types of fairly extensive acreage would have been desirable; and a brief appraisal of the economic importance of the forest in employment of labor, as a supplier of raw material to the many wood-using industries, would have rounded out the picture of the importance of forests in Wisconsin's economy.

Chapter 4, dealing with soil conservation and particularly with the Coon Valley Demonstration Watershed, might have stressed somewhat more the vital role of the Soil Conservation Service in changing the pattern of the farm landscape in the Valley as well as, on a larger scale, in the erosion-susceptible southwestern Driftless Area. The Upper Mississippi Valley Conservation Experiment Station at LaCrosse deserves more space. Here research of the most far-reaching consequences affecting land use and soil conservation was conducted by several agencies of the U. S. Department of Agriculture in cooperation with specialists of the University of Wisconsin.

This reader was surprised to see no mention of the commendable program of tree breeding started under Dr. Brink's supervision in the University Genetics Department.

A forester might question the acreage figure of white pine in Wisconsin, given as about 1 million acres; the recent Forest Survey estimate is 112 thousand acres. The discrepancy in acreage is no doubt due to the difference in definition of white pine type as used by Forest Survey technicians and the blister rust control personnel.

In summary, this book will serve admirably as a supplemental reference for conservation teachers; also it will aid technicians seeking references on the work of University of Wisconsin scientists and their notable contributions in furthering knowledge of the natural resources of the State of Wisconsin.

J. H. STOECKELER
Lake States Forest Experiment Station

Influence of Woodland and Owner Characteristics on Forest Management

A Survey of 505 Cases in the Tennessee Valley. 38 pp. Illus. TVA Division of Forestry Relations, Norris, Tenn.

Attention has been focused for more than a decade upon the small woodland ownership as the number one problem in forestry. Only a few foresters, however, have made objective studies of the owners, their reasons for holding forest property, and their actual performance. The current study of 505 case demonstrations established between 1943 and 1948 is, therefore, a welcome addition to the facts bearing upon this partially understood yet much talked about issue.

Each owner involved, by agreeing to establish a demonstration in forestry, displayed a positive in-

terest in improving his woodland. A survey was made in the fall of 1955 to determine the extent to which the owner had followed through. Properties that had changed hands were examined to determine each owner's contribution to woodland management.

Properties were rated as satisfactory, unsatisfactory, or marginal on the basis of the degree to which they had adhered to cutting budgets and cutting systems, and practiced satisfactory fire control and logging methods. The survey also determined whether or not desirable growing stock had increased or decreased in volume. On the basis of these criteria the owners were classified to determine those that did the best jobs.

In general, it was found that those having good timber, those with relatively large sized holdings, those who had held the land for ten years or longer, those beyond 40 years of age, and those who had attempted to improve their woodland before the case record was begun all tended to have more satisfactory performance than those having low timber volume, small holdings, ownership of less than ten years, and no previous experience in attempted forest management.

The individuals who were successful business managers were good woodlands managers. Those who used a consultant and those who were engaged in educational work uniformly had satisfactory woodland practice. Substantial income from timber was a strong incentive to good management. The findings are presented pictorially and in terse form. More such case studies are needed.

HARDY L. SHIRLEY

Publications of Interest

A forest service research technician and a university professor with a farm forestry background have combined their knowledge and experience to produce *How to Farm Your Forest*, a booklet which describes the steps necessary to place a farm woodland under proper management. Though prepared primarily as a guide for woodland owners in southern Illinois, this manual has valid applications and use throughout the Midwest hardwood region.

The authors cover the silvicultural and economic aspects of farm woodland management. Any timber-owning reader can quickly grasp the reasons for managing his woods, the basic technical aspects inherent to proper forestry, the methods and means of initiating a forest management program, and (perhaps most important of all) the costs and returns which can be expected.

The booklet includes an appendix listing sources of further personal (farm foresters) and informational guidance.

Copies may be obtained from Southern Illinois University, Carbondale, Ill.

* * *

Natural Regeneration on Staggered Settings is a presentation of the results of a study designed to analyze the effects of setting size and environmental factors upon natural regeneration of Douglas-fir.

The report is divided into two sections. The first section, by D. P. Lavender, Oregon State Board of Forestry, and M. H. Bergman, Willamett Valley Lumber Co., Dallas, Ore., deals with survey methods and compilation and analysis of data. The second, by Dr. L. D. Calvin, statistician for the Oregon State Agricultural Experiment Station, discusses statistical methods and formulae used. Also included is a tabular summary of results.

The 36-page booklet, published by the Oregon State Board of Forestry as Research Bulletin No. 10 is available from the publisher in Salem, Ore.

Skidding With Rubber-Tired Wheel Tractors in the Tennessee Valley is a 16-page report of a study made by the TVA to "evaluate wheel tractors as logging equipment, to check their efficiency and limitations under conditions found in the Valley, and to develop some typical cost data . . ." B. C. Cobb of the Forest Utilization Section is the author of the booklet. It can be obtained from the TVA, Norris, Tenn., without cost.

* * *

In its newest booklet, *Our Growing Wood Supply*, American Forest Products Industries, national sponsor of the Tree Farm movement, says the present forest situation "gives promise of adequate supplies of wood for our growing population in the years ahead."

The booklet points to the forest industry's role in expansion of forest management, greater utilization of all parts of the tree, fire prevention, better control of insects and disease, a growing roster of professional foresters, research development, and the American Tree Farm System itself as factors now contributing to the nation's growing wood supply.

Copies are available from AFPI, 1816 N St., NW, Washington 6, D. C.

* * *

In a new study, *Conservation is Good Business*, the National Chamber of Commerce describes many outstanding conservation programs being conducted by business and industry.

Thirteen experts representing all major industries in the natural resources field have contributed to the report. Besides answering common questions, it lists more than 60 pieces of literature available from business sources.

The 40-page booklet may be obtained at 50 cents a copy from the Natural Resources Department, Chamber of Commerce of the United States, 1615 H St., N. W., Washington 6, D. C. Discounts available for quantity orders.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University College of Forestry at Syracuse University*
Range Management Section Compiled by Division of Bibliography, Library, U. S. Department of Agriculture

General

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A Contribution to the Heritage of Every American: The Conservation Activities of John D. Rockefeller, Jr. By Nancy Newhall. 179 pp. Illus. Knopf, Publ., New York. 1957. $13.50.

John Muir, Protector of the Wilds. By Madge Haines and Leslie Morrill. Abingdon Press, Nashville, Tenn. 1957. Ages 8-12. $1.50.

State Forest Tax Law Digest 1956. By E. T. Williams. 86 pp. U. S. Forest Service, Washington 25, D. C. 1957.

Trail Blazers. By Coert duBois. Stonington Publ. Co., Inc., 161 Water St., Stonington, Conn. 1957. $3.75.

Farm Forestry

Forest Farmer Manual: A Guidebook for Southern Timberland Owners. 5th ed. 168 pp. Illus. Forest Farmers Ass'n. Coop., 66 11th St., NE, Atlanta, Ga. 1957. $4.

Marketing Forest Products from Small Woodland Areas in Maine. By Gregory Baker and F. K. Beyer. 15 pp. Maine Agric. Expt. Sta., Orono. 1956. Bul. No. 554.

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Tree Planting on the Farm. 4 pp. Illus. Iowa State College, Agric. Ext. Serv., Ames. 1957. Pamphlet No. 151, rev.

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Application of the Variable Plot Method of Sampling Forest Stands. By J. F. Bell and L. B. Alexander. 22 pp. Illus. Oregon State Board of Forestry, Salem, 1957. Res. Note No. 30.

Some Natural Factors That Govern the Management of Oaks. By Sidney Weitzman and G. R. Trimble, Jr. 40 pp. Illus. Northeastern Forest Expt. Sta., Upper Darby, Pa. 1957. Sta. Paper No. 88. Mimeog.

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Forest Inventory Statistics for Sequatchie County, Tennessee. 18 pp. TVA, Norris. 1957. Forestry Bul. No. 48. Mimeog.

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Les Déchets de Coupe dans l'Est du Canada. By J. A. Doyle. 25 pp. Illus. Ministre du Nord Canadien et des Resources Nationales, Ottawa. 1957. Bul. No. 115.

Skidding with Rubber-Tired Wheel Tractors in the Tennessee Valley. By B. C. Cobb. 16 pp. TVA, Norris. 1957. Technical Note No. 26.

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Black Turpentine Borer. By R. H. Smith and R. E. Lee. 7 pp. Illus. U. S. Dept. of Agric., Washington 25, D. C. 1957. Forest Pest Leaflet No. 12. 5 cents (Govt. Print. Off.).

Fir Engraver Beetle. By R. E. Stevens. 7 pp. Illus. U. S. Dept. of Agric., Washington 25, D. C. 1956. Forest Pest Leaflet No. 13.

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Forest Grazing in the Pine-Hardwood and Bottomland Hardwood Types of Southeast Texas. By T. H. Silker. 33 pp. Illus. Texas Forest Service, Austin. Bul. No. 47. July 1955.

Theory and Dynamics of Grassland Agriculture. By J. R. Harlan. 281 pp. Van Nostrand Co., Inc., Princeton, N. J. 1956. $6.75.

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Canoeable Waterways of New York State and Vicinity. By L. I. Grinnell. 410 pp. Illus. Pageant Press, Inc., New York. 1957. $5.

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Mechanical Scarification and Strip Clearcutting to Induce Lodgepole Pine Regeneration. By D. I. Crossley. 14 pp. Illus. Canada Forestry Branch, Ottawa. 1956. For. Res. Div. Tech. Note No. 34.

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Silvical Characteristics of Sugar Pine. By H. A. Fowells and G. H. Schubert. 19 pp. California Forest and Range Expt. Sta., Berkeley. 1956. Tech. Paper No. 14. Mimeog.

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Some Properties of 144 Soils from the Intermountain States. By R. E. Taylor. 6 pp. Tables. Intermountain Forest & Range Expt. Sta., Ogden, Utah. 1956. Misc. Publ. No. 7. Mimeog.

Wood Technology and Utilization

Effect of Prestressing on Mechanical Properties of Douglas-Fir and Southern Yellow Pine. By L. W. Wood. 5 pp. Tables. U. S. Forest Products Laboratory, Madison, Wis. 1957. Rept. No. 2073. Mimeog.

Wood-Using Industries of New York. By R. C. Deckert and R. J. Hoyle. 124 pp. Illus. State University College of Forestry, Syracuse 10, N. Y. 1957. Tech. Publ. No. 27 (rev.). $1.50.

Society Affairs

Officers and Council
1956-1957

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Department of Natural Resources
315 State Office Building 1
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Savannah, Ga.

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New Orleans 13, La.

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Tallahassee, Fla.

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Portland 8, Ore.

HENRY J. VAUX
School of Forestry
University of California
Berkeley 4, Calif.

The President's Column

DEWITT NELSON

In the April issue of the JOURNAL OF FORESTRY there were two very different and yet closely allied subjects presented. One, "A Panel Discussion of the Place and Functions of the Division of Range Management in the Society of American Foresters," and two, "The Training of Men in Forest Hydrology and Watershed Management."

Two very different topics but subjects which emphasize the need for foresters to expand their horizons to encompass their full responsibilities. Foresters today, federal, state, or private, cannot ignore these two important fields of wildland management. Full utilization of the growing resources and full protection of the growth capacity of the land requires in many instances the management for both forest and forage and in practically every instances should require management for watershed protection purposes.

Every state in the Union is becoming water conscious and water problems are becoming major issues. Soon the states will realize that water production (both quality and quantity) is closely allied with the treatment and management that the vegetative crops of the wildlands receive. Foresters and range managers alike should be prepared to assume their share of the responsibility in this management program.

The question of soil erosion, stream damage and water pollution from land management practices are before the legislatures of several states this spring. We as professional men should take the lead in developing methods and techniques to prevent such damage before we are forced to do so through legislative action.

No longer can the forester confine his activities within the "shadow of the tree." The results of his activities reach far beyond that shadow. We are living in a time when the downstream development depends greatly upon the management of the upstream lands. The competition for land and resource use is growing rapidly. The conflicts of ideals and philosophies are being brought into sharper focus. If proper balance of the multiple-use principle cannot be accomplished we may see more and more good land and resources dedicated to a single use. Such dedication would not be to the best interest of the forest or range owner and operator, yet I believe that released public emotion could threaten such a move.

If we are wise we will take a good long look at the necessity for recognizing these growing needs and manage our resources to meet the problem before legislation forces drastic and severely handicapping controls.

DeWitt Nelson

Coming Events

Forestry Physiology Symposium

A symposium on tree physiology will be held at the Ohio Agricultural Experiment Station, Wooster, Ohio June 13-14.

Forest Products Research Society

The Forest Products Research Society will hold its national annual meeting June 24-27 in Buffalo, N. Y., at the Hotel Statler.

Northeastern Forest Tree Improvement Conference

The Northeastern Forest Tree Improvement Conference will be held in Orono, Maine, August 22 and 23.

National Watershed Congress

The National Watershed Congress is scheduled for September 23-25 in the Biltmore Hotel, Atlanta, Ga.

Society of American Foresters

The 57th annual meeting of the Society of American Foresters will be held November 10-13, 1957 in the Syracuse Hotel, Syracuse, N. Y.

Schedule of Proposed FAO Meetings

Asia-Pacific Forestry Commission, 4th Session; Bandung; June 8-21.

Latin American Forestry Commission, 6th Session; Geneva; July 30-Aug. 10.

FAO/ECE Working Party on Tractor Testing; Geneva; Sept. 16-20.

FAO/IUFRO Committee on Bibliography; Helsinki; Undetermined.

Training Centers and Seminars

Near East Training Course on Poplar Cultivation; Turkey; Undetermined.

Fifth Call for Council Nominations

All members are hereby notified that the regular biennial election will be held December 2, 1957. A president, vice president, and nine other members of the Council will be elected for the two-year term 1958-1959.

The present Council is listed in the box on page 475. Any or all of these incumbents may be renominated, provided they accept the nomination in writing.

President DeWitt Nelson has announced that he will not be a candidate for re-election.

Membership on the Council is restricted by the Constitution to Members (formerly Senior Members) and Fellows. Any Member or Fellow is eligible to hold office who is in good standing and who accepts the nomination in writing and declares his willingness to serve if elected.

Each voter will have an opportunity to ballot on all candidates for office. Council members are elected in accordance with the system of proportional representation. The procedure of proportional representation will be explained in a later issue of the JOURNAL. It is the system by which the Society has been electing Council members for over two decades.

Candidates for the office of president are voted on separately; the candidate who receives the highest vote is declared elected president, and the candidate who receives the next highest vote is declared elected vice president.

How Nominations Are Made

The Constitution (Article VIII, Section 2) states the conditions under which nominations are made by petition.

1. Each petition shall name but one candidate.
2. All candidates must be eligible to hold elective office.
3. A petition shall bear the signatures of at least ten voting members who at the time of signing the petition are eligible to vote in the coming election. (Eligible voting members are Junior Members, Members, and Fellows in good standing.)
4. A voting member may not sign more than one nominating petition for president, nor more than one nominating petition for a member of the Council. That is, he may sign two, but no more.
5. Petitions must be in the Society office by September 18, 1957.

The Society has no special form for submitting nominating petitions. They may be written as follows:

We, the undersigned voting members of the Society of American Foresters, hereby nominate John Doe, a Member (or Fellow) for the office of president (or member of the Council) for the two-year term 1958-1959.

All nominating petitions should be sent promptly to the Society office. The executive secretary will gladly provide information about nominating or election procedure.

According to the Constitution (Article VIII, Section 1) a Nominating Committee has been appointed by President Nelson. The Committee is composed of the following members:

Chairman, J. H. Johnson, Chesapeake Corp. of Virginia, Box 534, West Point, Va.

S. T. Carlson, National Park Service, P. O. Box 1728, Santa Fe, N. Mex.

Albert Engstrom, Oklahoma Division of Forestry, Capitol Building, Oklahoma City, Okla.

James E. Sowder, Deschutes Research Center, U. S. Forest Service, Bend, Ore.

Harry E. Troxell, School of Forestry, Colorado A & M College, Fort Collins, Colo.

This committee is charged with the following duties:

Important Notice to Subscribers

If you change your address please notify the JOURNAL OF FORESTRY, preferably in advance, by letter, post card, or post office form number 22-S. Be sure to give your old, as well as the new, address with your postal zone number if any.

You should also notify your local post office on postal form number 22 of your change of address. Both postal forms are obtainable at any post office.

Copies of the JOURNAL will not be forwarded by the Post Office Department. Hence, in order to avoid missing your copy as well as to prevent extra expense to the Society in supplying duplicates, you are urged to notify the JOURNAL as soon as you know your new address, a month in advance of change if possible.

JOURNAL OF FORESTRY
425 Mills Building
17th Street at Pennsylvania Avenue, N. W.
Washington 6, D. C.

1. To set the date of the election. (December 2, 1957 is the date.)

2. To provide for at least two candidates for the office of president, and at least nine candidates for membership on the Council.

3. To receive separate nominating petitions for the office of president and for each member of the Council, and to supplement such petitions when necessary with other nominations in order to comply with item 2 above.

The Nominating Committee will make no nominations of its own unless the voting membership fails to make the required minimum number of nominations by petition. Voting members should accordingly get busy and make their own nominations. For their information the distribution of Council members by states during the period 1942-1957 is shown on page 388 of the May issue of the JOURNAL.

Nominations Received

Up to the time of going to press the following nominations had been received:

For President

George A. Garratt, New Haven, Conn. (Vice president, 1956-1957).

Henry J. Malsberger, Atlanta, Ga.

For The Council

B. E. Allen, Savannah, Ga. (Council member, 1956-1957.)

Philip A. Briegleb, New Orleans, La. (Council member 1956-1957.)

S. T. Carlson, Santa Fe, N. Mex.

Kenneth P. Davis, Ann Arbor, Mich.

M. B. Dickerman, St. Paul, Minn.

Glen R. Durrell, Stillwater, Okla.

M. K. Goddard, Harrisburg, Pa. (Council member, 1956-1957.)

P. T. Lannan, Georgetown, S. C.

A. D. Nutting, Orono, Maine.

J. Herbert Stone, Portland, Ore. (Council member, 1956-1957.)

Henry J. Vaux, Berkeley, Calif. (Council member, 1956-1957.)

J. H. JOHNSON, *chairman,*
Nominating Committee

Fifth Call for Fellow Nominations

All Members (formerly Senior Members) and Fellows of the Society are hereby advised that nominations for the grade of Fellow are now open. The election of Fellows will be held at the time of the Society's regular biennial election, December 2, 1957.

As defined by the Constitution (Article III, Section 7), "Fellows shall be foresters of outstanding achievement as leaders in responsible directive or distinctive individual work of a fruitful character. They shall be elected from the Members and shall be engaged in forestry work at the time of their election."

Nominations by Petition

The procedure for placing Members in nomination for the grade of Fellow is by petition. The Society has no printed form for this purpose; the petition may be typewritten thus:

We, the undersigned Members and Fellows of the Society of American Foresters, hereby nominate John Doe for election to the grade of Fellow in 1957.

Remember these simple rules:

1. A petition may not name more than one candidate.

2. It must be signed by 25 Members or Fellows in good standing.

3. It should be accompanied by a factual, not eulogistic, biographical sketch of at least 200 words giving an

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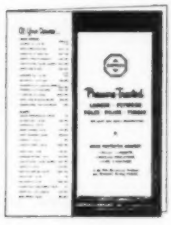

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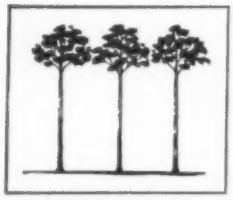

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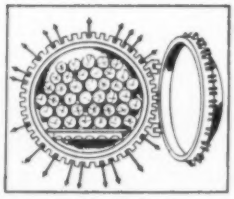

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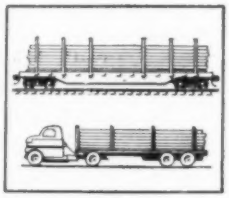

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account of the nominee's professional career and accomplishments.

4. It must be received in the executive office of the Society in Washington, D. C., not later than September 18, 1957.

The executive employees of the Society cannot be responsible for obtaining signatures on partially completed petitions or on petitions incomplete by reason of unacceptable signatures (that is, signatures of other than Members and Fellows in good standing).

Election Procedure

Fellows are not elected by the membership at large, but by a board of electors which consists of all present Fellows and the present Council. (A Council member who is also a Fellow has but one vote.)

The system is described in Article IV, Section 4 of the Constitution. To win election a candidate must receive an affirmative vote of not less than one-half the total votes cast.

During 1957, the voting membership of the Society will have an opportunity to ballot on a proposal by the Council that would increase the number of Fellow electors. If the referendum is approved, the chairmen of the 21 Sections and the chairmen of the 11 subject Divisions, a total of 32 electors, will cast votes for Fellows in addition to the present Fellows and the Council. For a detailed discussion of this proposal members are referred to the JOURNAL for April 1956, page 279, and for June 1956, page 410.

Significance of the Grade

The highest membership distinction that can be conferred by the Society, this grade is awarded in recognition of outstanding achievement. Fellows do not pay increased dues; their dues are the same as those of Members.

Since the Society was founded in 1900, there have been 109 Fellows elected. At the present time the number of living Fellows is 75.

List of Fellows

The current roster of Fellows follows. The state in which each Fellow is domiciled and the year of his election are shown after his name.

Allen, Shirley W. Michigan. 1948.
Bailey, Reed W. Utah. 1955.
Baker, Frederick S. California, 1949.
Besley, Fred W. Maryland. 1940.
Boyce, John S. Connecticut. 1955.
Brundage, Frederick H. Oregon. 1949.
Butler, Ovid. Maryland. 1940.

Carter, E. E. District of Columbia. 1942
Chapman, Herman H. Connecticut. 1922.
Clapp, Earle H. District of Columbia. 1930.
Clepper, Henry E. Virginia. 1949.
Coffman, John D. California. 1946.
Cox, William T. Minnesota. 1953.
Curran, Hugh. Venezuela. 1951.

Damtoft, Walter J. North Carolina. 1951.
Dana, Samuel T. Michigan. 1935.
Demeritt, Dwight B. Maine. 1955.
Demmon, Elwood L. North Carolina. 1951.
Detwiler, Samuel B. Colorado. 1955.
Drake, George L. Washington. 1953.

Eldredge, Inman F. Lousiana. 1942.
Evans, Charles F. Georgia. 1949.
Evenden, J. C. Idaho. 1953.

Ferguson, J. A. Pennsylvania. 1949.
Fischer, Arthur F. California. 1940.
Fontanna, Stanley G. Michigan. 1955.
Fritz, Emanuel. California. 1951.
Frothingham, E. H. California. 1942.

Garratt, George A. Connecticut. 1953.
Gill, Tom. District of Columbia. 1948.
Granger, Christopher M. Maryland. 1946.
Guise, Cedric H. New York. 1951.
Guthrie, John D. Virginia. 1942.

Hall, J. Alfred. Wisconsin. 1955.
Hall, William L. Arkansas. 1940.
Hartley, Carl P. Maryland. 1949.
Hawes, Austin F. Connecticut. 1939.
Hawley, Ralph C. Connecticut. 1942.
Heintzleman, B. Frank. Alaska. 1951.
Holmes, J. S. North Carolina. 1939.
Hosmer, Ralph S. New York. 1932.
Hunt, George M. Wisconsin. 1951.

Illick, Joseph S. New York. 1946.
Isaac, Leo A. Oregon. 1953.

Jeffers, Dwight S. Oregon. 1948.

Kaufert, Frank H. Minnesota. 1955.
Keen, Frederick P. California. 1955.
Kelley, E. W. California. 1949.
Kellogg, Royal S. Florida. 1949.
Kinney, Jay P. New York. 1942.
Kittredge, Joseph. California. 1953.
Korstian, Clarence F. North Carolina. 1942.
Krueger, Myron E. California. 1951.

Lowdermilk, Walter C. California. 1948.

MacDonald, G. B. Iowa. 1944.
Marckworth, Gordon D. Washington. 1955.
Marsh, Raymond E. District of Columbia. 1948.
Martin, Clyde S. Washington. 1948.
Mason, David T. Oregon. 1948.
McArdle, Richard E. District of Columbia. 1953.
Metcalf, Woodbridge. California. 1953.
Morrell, Fred W. Virginia. 1951.
Munger, Thornton T. Oregon. 1946.
Munns, Edward N. California. 1949.

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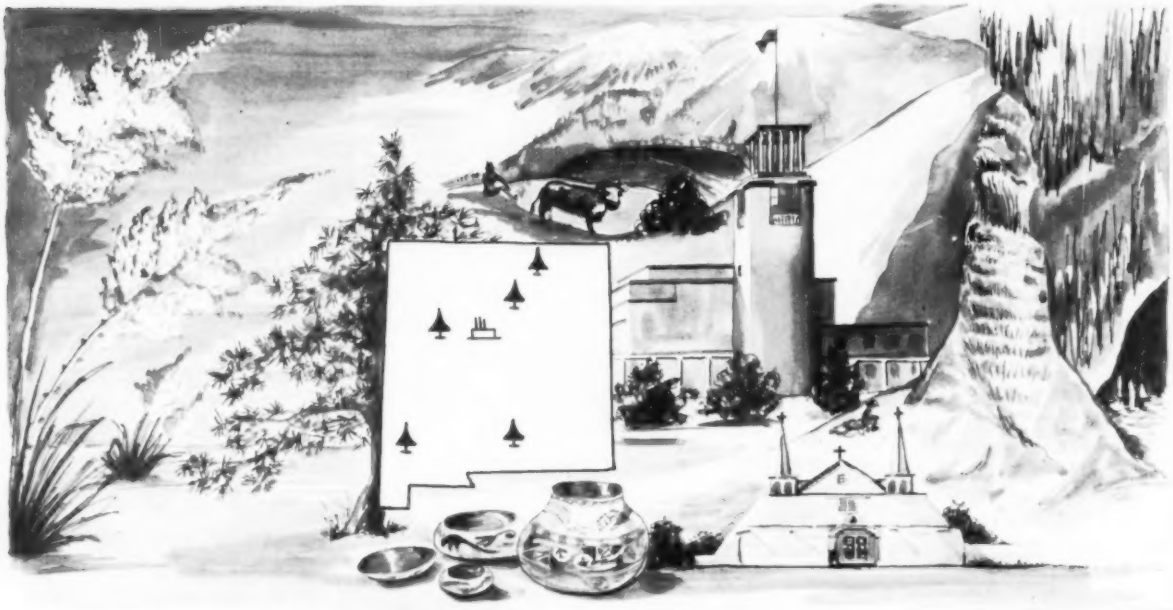

New Mexico

With highways and railroads following the easy paths through valley and desert first used by early pioneers and explorers of the Southwest, the casual traveler through New Mexico would little suspect that a large part of the state is heavily timbered.

With a total area of 78,000,000 acres, the forested areas of New Mexico furnish hunting, fishing and recreational areas for not only residents of the state, but also for over 3,000,000 visitors each year from other parts of the country.

There are approximately 130 species of trees native to the state, of which four make up 98% of the sawtimber stand. These are Ponderosa Pine, 82%; Douglas Fir, 10%; White Fir, 3%; and Engleman and Blue Spruce the other 3%.

During 1956 the allowable cut from the five National Forests in the state was 120,000,000 board feet. Another 50,000,000 board feet was contributed from other Federal lands within the state. While exact figures are not available for footage of lumber cut from the state's trust lands and from privately owned lands, it is estimated that the total allowable cut in New Mexico for 1956 was in excess of 200,000,000 board feet.

With a limited local market, the bulk of this timber is shipped to markets in Central and Eastern states, from the 60 sawmills now in operation in the state.

A recent survey by the Economic Development Commission of New Mexico indicated that there were only one pulpwood mill and 7 paper mills in a 9 state area including New Mexico, with a total production of 200,000 tons of paper annually. Considering the fact that this is only approximately one-eighth of the amount of paper used in the area, a study is now being made as to the practicability of attracting new paper mills into the area.

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Preston, John F. District of Columbia. 1948.
Price, Jay H. Arizona. 1951.
Schmitz, Henry. Washington. 1940.
Shirley, Hardy L. New York. 1951.
Show, S. B. California. 1948.
Siecke, E. O. Texas. 1946.
Sparhawk, William N. New Hampshire. 1946.
Watts, Lyle F. Oregon. 1946.
Winslow, C. P. Washington. 1942.
Wirt, George H. Pennsylvania. 1948.
Ziegler, E. A. Pennsylvania. 1949.

Fellow Nominations

On the date of going to press, the following Members had been nominated for the grade of Fellow:

James F. Dubuar, Wanakena, N. Y.
Svend O. Heiberg, Syracuse, N. Y.
Harvey J. MacAloney, St. Paul, Minn.
DeWitt Nelson, Sacramento, Calif.

Columbia River Section Holds Annual Meeting

Some 400 foresters and guests gathered in Salem, Ore., March 30, at the Marion Hotel for the annual meeting of the Columbia River Section.

Society President DeWitt Nelson discussed "Topics of National Importance to Professional Foresters." Also included in the one-day meeting, which began with a welcoming address by Gov. Robert D. Holmes, were various panel discussions and resolutions.

Discussing the topic, "What Do Young Foresters Get Other Than a Paycheck," students from the Oregon State College of Forestry outlined what a student expects from the employer, and what the employer should expect of the student after his graduation as a forester.

In a panel discussion of "Seed and Seedlings — What's New," panelists pointed out that one of the biggest problems facing reforestation is the growing demand for tree seed, which is needed to continue the expansion of reforestation. At present rates of expansion, by 1962 some 60 tons of seed would be needed each year for seeding.

Wilderness areas, watershed protection, and research were covered in resolutions adopted by the Section.

The Section opposed the Humphrey bill which would create a national wilderness preservation system on the grounds that it tends "to create a legislative history inconsistent with the principle of multiple use of forest lands." It urged watershed research on major drainages in Oregon and appointed a committee to work with the Oregon Water Resources Board on this subject and endorsed the present program of forest research.

A banquet and social hour closed the conference. H. B. Douglas, division manager of Richfield Oil Company of Seattle, was the featured speaker at the banquet. His topic was "Methods of Solving Relations Problems."

Dan D. Robinson, chairman of the Section, presided. Robert Mason was chairman of the planning committee for the meeting.

Dues Deadline Is June 30

Members who have not paid their 1957 dues will receive a letter and dues-memorandum this month. Members whose dues are not paid by June 30th will be declared in bad standing. They will not receive the Society's publication, be a candidate for office, or be eligible to vote until their dues are paid. *This is an election year* so make sure that your vote will be counted, by paying your 1957 dues now.

New Chapters Formed

Recently two additional chapters for the Appalachian Section were organized—Edisto and Southeastern Virginia—making three chapters with the already organized Wingah chapter.

Effective July 1st the Salem chapter will be organized, making 11 chapters for the Columbia River Section.

Only seven of the 21 Sections now have no chapters.

Wisconsin-Michigan Section Discusses Insect Problems at Winter Meeting

One hundred eighty members and guests attended the banquet and activities at the annual winter meeting of the Wisconsin-Michigan Section in Iron Mountain, Mich. March 15 and 16.

Highlight of the forestry program during the two-day meeting was an excellent panel discussion of forest insect problems in Wisconsin and Michigan. Dr. T. D. Stevens of Michigan State University presided as Section chairman. Principal speaker at the

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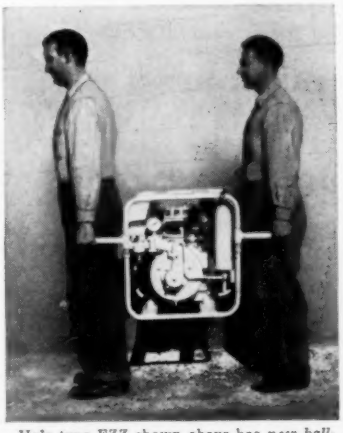

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banquet was Dr. Harold E. Sponberg, vice-president of Northern Michigan College of Education. The entertainment program also included a tour of the Kingsford Chemical Co., Kimberly-Clark of Michigan, Inc., and the Nelson Paint Co.

Dr. S. A. Graham, University of Michigan, served as moderator of an illustrated panel discussion of forest insects. Other panel members were Norman F. Smith, Ronald Renlund, Jack B. Cody, Arnold Drooz, Paul R. Flink, and Daniel M. Benjamin. Serving on the arrangements committee for the meeting were Roy Eggan (chairman), D. O. Preilipp, P. B. Thomas, O. J. Hatle, A. L. Swanson, J. B. Cody, and R. E. Davidson.

John Macon of the Consolidated Power and Paper Co., Rhinelander, Wis., was elected Section chairman for the year beginning in July. Elected to serve with him were Donald G. Zettle as vice-chairman, and Donald Preilipp as secretary. Site for the summer meeting of the Wisconsin-Michigan Section will be at Manistee, Mich.

Retired Status

Members and Fellows who retire from full-time employment, either in forestry or other fields, after having been Society members for 20 years or more may, upon application, continue as voting members, but have their dues remitted except for an annual charge of $5 should they desire to receive the JOURNAL OF FORESTRY.

Members granted such retired status in the Society must continue to pay Section dues in order to continue, if they wish, as Section members.

Inactive Status

Society members temporarily serving in the Armed Forces may request that they be placed on inactive status. Inactive members do not receive copies of the JOURNAL OF FORESTRY, nor are they permitted to vote. They are considered as members of the Society and may be restored promptly to active status upon their return to civilian life, with the payment only of current dues.

O. T. Swan (1880-1957)

O. T. Swan, a member of the Society of American Foresters for 46 years, died April 3 in Oshkosh, Wis.

Born May 25, 1880, in Mechanic Falls, Maine, Mr. Swan spent five years at the University of Nebraska taking general collegiate and forestry courses, graduating with the A.B. degree in 1904 and the B.S.F. degree in 1905.

Entering the U. S. Forest Service in 1905, he was first assigned to nursery work, later conducted experiments in pole preservation. Following a trip to western Europe in 1909-1910 studying wood preservation methods, he was placed in charge of the Branch of Products in the Washington, D. C. office.

In 1915 he was appointed secretary-manager of the Northern Hemlock and Hardwood Manufacturers Association with headquarters in Oshkosh, which position he held until his retirement several years ago.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatements received in the Society office during the month of April are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of July 1, 1957. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Balok, V. B. — Schaeffer, R. M.
Odell, R. L. — Swartz, K. D.

Junior Grade

Students Eligible for Automatic Advancement

PENNSYLVANIA STATE UNIVERSITY

Byrne, J. G.

WEST VIRGINIA UNIVERSITY

Foley, W. P. — Howard, R. L.
Gabbert, C. L. — Laneve, A. P.
Headlee, T. M. — Litten, C. D.
O'Brien, D. E.

Member Grade

Hill, J. A., Forester, Dept. of Forests & Waters, Mont Alto, Pa.; State Univ. of N. Y., B.S.F., 1950; M.S., 1953. (Junior 1951).

Affiliate Grade

Fetterman, L. S., Forester, Johnstown Water Co., Johnstown, Pa.
Johnston, J. M., Forest Inspector, Pa. Dept. of Forests & Waters, Ligonier, Pa.

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MANTON, MICHIGAN

Appalachian Section

Junior Grade

Jamison, O. T., Dist. Forest Ranger, USFS, Hot Springs, N. C.; V.P.I., B.S., (Forestry), 1950. (Affiliate 1954).
Kundt, J. F., Dist. Mgmt. Chief, Waverly, Va. Reinstatement.
Lewis, S. E., Consulting Forester, self employed, Goldsboro, N. C.; N. C. State, B.S.F., 1952.

Students Eligible for Automatic Advancement

NORTH CAROLINA STATE COLLEGE

Boulogne, P. M.	Kelley, J. S.
Duckworth, C. A.	Leinbach, G. N.
Hood, C. A.	Perry, J. U.

Member Grade

Johnston, C., Area Forester, W. Va. Pulp & Paper Co., Walterboro, S. C.; Univ. of Ga., B.S.F., 1952. (Junior 1952).

Affiliate Grade

Driver, B. L., Timberville, Va.; V.P.I., B.S., (Forestry), 1957.
Powell, M. L., Forestry Aide, USFS, Covington, Va.

Central Rocky Mountain Section

Student Grade

COLORADO STATE UNIVERSITY

Kidney, D. E.

Member Grade

Bean, P. W., 1269 South Zenobia, Denver, Colo. (Junior 1950).
Meines, M. K., Forester, USFS, Halsey, Neb. (Junior 1950).
Winter, T. L., Box 915, Bridgeport, Neb. (Junior 1947).

Central States Section

Junior Grade

Hansen, F., 700 N. 5th St., Lafayette, Ind.; Purdue, B.S.F., 1955.
Jarek, W., In Training, Caterpillar Tractor Co., Peoria, Ill.; State Univ. of N. Y., B.S.F., 1953.
Skelly, J. S., Logging Representative, Caterpillar Tractor Co., Peoria, Ill.; Utah State, B.S.F., 1953.

Students Eligible for Automatic Advancement

Gamble, R. L.	King, C. D.
Hmurovich, M. J.	Law, J. R.
Hudson, D.	Raetzman, M. E.

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Appel, T. A.	Poppino, J. H.
Hanson, D. C.	Schmitz, R. F.

Junior Grade

Bjornsen, R. L., Dist. Ranger, USFS, Wallowa, Ore.; Utah State Agric., B.S., (Range Mgmt.), 1950. (Affiliate 1953).
Brigham, J. H., Forester, Ga. Pacific Corp., Toledo, Ore.; Ore. State, B.S.F., 1947.
Carligh, J. L., Land Surveyor, Self Employed, Tillamook, Ore.; Ore. State, B.S.F., 1938.
Holt, B. W., Tbr. Mgr., Paul B. Hult Lbr. Co., Dillard, Ore.; Univ. of Idaho, B.S.F., 1951.
Jones, F. W., Tbr. Mgmt. Asst., USFS, Lakeview, Ore.; Ore. State, B.S.F., 1937.

Member Grade

Clarke, E. H., Research Forester, Pacific N.W. Forest & Rge. Expt. Sta., Portland, Ore.; Iowa State, B.S.F., 1942; State Univ. of N. Y., M.S., 1948. (Junior 1949).
Curtis, L. B., Regeneration & Rehabilitation Forester, Weyerhaeuser Tbr. Co., North Bend, Ore. (Junior 1950).
Eversole, K. R., Tbr. Mgmt. Asst., Hemlock Rgr. Sta., Carson, Wash. (Junior 1950).
Fisher, C. D., Forester, Columbia Veneer Co., Kalama, Wash. (Junior 1950).
Gavin, W. H., Asst. Unit Forester, Bur. of Land Mgmt., Medford, Ore., Univ. of Calif., B.S.F., 1952. (Junior 1952).
Graham, E. D., Forester, USFS, Portland, Ore. (Junior 1950).
Hirschberg, S. B., Logging Engr., L & H Lbr. Co., Sutherlin, Ore.; Univ. of Idaho, B.S.F., 1951. (Junior 1952).
Host, J. R., Project Engr., Wash. State Dept. of Natural Res., Yacolt, Wash. (Junior 1950).
Hunt, F. M., Asst. Agriculturist, Hawaiian Commercial & Sugar Co., Hawaii (Junior 1950).
Nelson, R. L., Tbr. Cruiser, Mason, Bruce & Girard, Portland, Ore. (Junior 1950).
Round, H. A., Sales Representative, Reichhold Chemicals Inc., Seattle, Wash. (Junior 1949).
Slade, R. S., Woodland Conservationist, Soil Conservation Service, St. Helens, Ore. (Junior 1950).
Thorpe, L. M., Forester, Gifford Pinchot Natl. Forest, Vancouver, Wash. (Junior 1950).
Wylie, Lbr. Clerk & Analyst, American Forests Products Corp., Lakeview, Ore. (Junior 1950).

Affiliate Grade

Price, J. C., Forester, USFS, Roseburg, Ore.; Univ. of Wash., B.S., (Zoology-Forestry), 1939.
Smiley, M. F., Forester, Bureau of Indian Affairs, Warm Springs, Ore.; Univ. of N. H., B.S., (Forestry), 1948.

Gulf States Section

Student Grade

LOUISIANA STATE UNIVERSITY

Allen, K. J.	Gordy, P. R.
Branton, D. W.	Greeman, M. G.
Cole, B. R.	Rodgers, T. E.
Storall, A.	

Junior Grade

Biskamp, L. A., Forester, Lutcher & Moore Lbr. Co., Orange, Texas; Stephen F. Austin State College, B.S., (Forestry), 1950. (Affiliate 1955).
Chestnutt, W. F., Asst. Forester, Texas Forest Service, Linden, Texas; Pa. State, B.S.F., 1956.
Childs, M. R., Assoc. Wood Utilization Tech., Texas Forest Service, Lufkin, Texas; Univ. of N. H., B.S., (Forestry), 1955. (Affiliate 1955).
Engelking, T. G., Mgr., East Texas Wood Treating Co., Nacogdoches, Texas. Reinstatement.
French, C. S., Forester, International Paper Co., Carthage, Texas; L.P.I., B.S.F., 1951.
Morgan, C. H., Eng. Aide, U. S. Corps of Engr., Jackson, Miss.; Univ. of The South, B.A., (Forestry), 1949. (Affiliate 1951).
Schombert, J. D., Project Forester, USFS, Oxford, Miss.; Mich. State, B.S.F., 1952.

Member Grade

Lewis, R. F., Dist. Supt., International Paper Co., Moss Point, Miss.; La. State, B.S.F., 1949. (Junior 1951).
Pettey, J. R., Regional Mgr., Southern Tbr. Mgmt. Service, Inc., Jackson, Miss.; Univ. of the South, B.S., (Forestry), 1948; Yale, M.F., 1950. (Junior 1951).
Stamer, A. E., Forester, USFS, Hemphill, Texas; Pa. State, B.S.F., 1952; M.F., 1953. (Junior 1953).

Affiliate Grade

Huston, J. E., Forester, International Paper Co., Doucette, Texas; Stephen F. Austin State College, B.S., (Forestry), 1952.
King, J., Forester, USFS, Brooklyn, Miss.
Martin, G. E., Dist. Forester, Southland Paper Mills, Inc., Lufkin, Texas;

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Stephen F. Austin State College, B.S., (Forest Mgmt.), 1953.
Youngblood, B. W., Dist. Forester, Southland Paper Mills, Inc., Livingston, Texas; Stephen F. Austin State College, B.S., (Forestry), 1952.

Intermountain Section

Student Grade

UTAH STATE AGRICULTURAL COLLEGE
Beaver, H. G.

Kentucky-Tennessee Section

Junior Grade

Morgan, W. T., Forester, T.V.A., Norris, Tenn.; La. State, B.S.F., 1949.

New England Section

Student Grade

UNIVERSITY OF MASSACHUSETTS
Mueller, W. S.

Junior Grade

Messeck, W. H., State Forester, N. H. State Forestry Dept., Concord, N. H.; Univ. of Maine, B.S.F., 1937.

Students Eligible for Automatic Advancement

Seaward, C. A. Tonnesen, J. E.

Member Grade

Sawyer, R. L., Resident Forester, N. E. Forestry Foundation, Lewiston, Maine; Univ. of Maine, B.S.F., 1951. (Junior 1951).

New York Section

Junior Grade

Wheeler, S. A., County Forester, Otsego County, Cooperstown, N. Y. (Affiliate 1955).

Northern California Section

Student Grade

UNIVERSITY OF CALIFORNIA
Petersen, J.

Northern Rocky Mountain Section

Student Grade

MONTANA STATE UNIVERSITY
Dupuis, K. W. Uphill, T. R.
Muraro, S. J. Weingart, P. D.

Member Grade

Moore, W. R., Dist. Ranger, USFS, Lolo, Mont. (Junior 1951).

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI
Austin, S. B.

Junior Grade

Henley, W. J., Forester, USFS, Glenwood, Ark.; Purdue, B.S.F., 1950.

Affiliate Grade

Hambrich, Dist. Forest Ranger, USFS, Hot Springs, Ark.; Stephen F. Austin State College, B.S., (Forestry), 1953.
Jacobson, R. A., Forester, USFS, Oden, Ark.; Ark. A & M, B.S., (Forestry), 1956.
Purvis, C. T., Dist. Forester, Ark. State Forestry Comm., Jonesboro, Ark.; Ark. A & M, B.S., (Forestry), 1956.

Puget Sound Section

Affiliate Grade

Gray, J. A., Forester, Industrial Forestry Service, Ltd., Prince George, B. C., Canada; Univ. of B. C., B.S., (Forestry), 1957.

Associate Grade

Wadsley, E. T., Vice President & Gen. Mgr., Mora Chemical Corp., Seattle, Wash.

Southeastern Section

Student Grade

UNIVERSITY OF FLORIDA
Harris, C. E.
UNIVERSITY OF GEORGIA
Steagall, W. A.

Junior Grade

Bishop, G. E., Chief, Forest Administration, Ga. Forestry Comm., Macon, Ga. (Affiliate 1954).
Brooks, E. M., Forester, Branco Wood Products, Brewton, Ala. (Affiliate 1952).
Byrus, W. C., Asst. Forester, St. Joe Paper Co., West Bay, Fla.; Iowa State, B.S.F., 1954.
Wynens, J. C., Reforestation Field Asst., Ga. Forestry Comm., Macon, Ga.; Univ. of Ga., B.S.F., 1949.

Students Eligible for Automatic Advancement

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Mackay, W. R. Royal, W. J.

Member Grade

Hixon, F. T., Operations Forester, Gulf States Paper Corp., Tuscaloosa, Ala.; A.P.I., B.S.F., 1950. (Junior 1951).
Holt, V. J., Asst. Forest Supv., Union Bag-Camp Paper Corp., Wayerosse, Ga.; Univ. of Ga., B.S.F., 1952. (Junior 1952).
Miller, S. R., Jr. Research Forester, Union Bag-Camp Paper Corp., Savannah, Ga.; Univ. of Mich., B.S.F., 1952; M.F., 1956. (Junior 1952).
Wood, G. W., Asst. Forester, Gulf States Paper Corp., Tuscaloosa, Ala.; A.P.I., B.S.F., 1950; Duke, M.F., 1952. (Junior 1952).

Southwestern Section

Member Grade

Crellin, J. S., Asst. Ranger, USFS, Jemez Springs, N. Mex.; Iowa State, B.S.F., 1953. (Junior 1953).

Affiliate Grade

Clayton, J. A., Forester, USFS, Flagstaff, Ariz.; Okla. A & M, B.S., (Forestry), 1957.

Upper-Mississippi Valley Section

Student Grade

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Junior Grade

Ridlington, K. S., Forester, Iron Rge. Res. & Rehabilitation, Hibbing, Minn.; Univ. of Minn., B.S.F., 1951.

Students Eligible for Automatic Advancement

IOWA STATE COLLEGE

Haygreen, J. H. — Ketchum, R. L.
Kastelic, J. P. — Miles, R. L.

Wisconsin-Michigan Section

Junior Grade

Students Eligible for Automatic Advancement

UNIVERSITY OF MICHIGAN

Jones, D. R. — McGarvey, B. H.
Kincaid, H. R. — Taft, K. A.
Tincoff, T. F.

Member Grade

Cooley, J. R., Graduate Student, Univ. of Mich., Ann Arbor, Mich.; Univ. of Mich., B.S.F., 1951. (Junior 1952).

Pearson, J. R., 9297 W. Potter Rd., Flushing, Mich. (Junior 1950).

Storer, J. W., Regional Mgr. & Forester, Osmose Wood Preserving Co., Madison, Wis.; Pa. State, B.S.F., 1950. (Junior 1953).

Walton, S. A., Forester, Koppers Co. Inc., Wood Preserving Div., Marietta, Ohio; Pa. State, B.S.F., 1951. (Junior 1951).

Affiliate Grade

Smith, R. V., Forester, Con. Water Power & Paper Co., Iron River, Mich.

No Section

Junior Grade

Tappeiner, J. C., % F.P.O., San Francisco, Calif.; Univ. of Calif., B.S.F., 1957.

Corresponding Grade

Bazan, F., Director del Programa Cooperativo para el Desarrollo Forestal del Peru, Ministerio de Agricultura, Lima, Peru; Univ. of Mich., M.F., 1945.

Chaudhury, A. M., Deputy Con. of Forests, Government of East Pakistan, Dacca, East Pakistan; Indian Forest College & Pakistan Forest College, Diploma, 1948.

Francia, F. C., Forest Products Entomologist, Bureau of Forestry, College, Laguna, Philippines; Univ. of Philippines, B.S., (Forestry), 1952; State Univ. of N. Y., M.S., (Entomology), 1957.

Juni, R. A., Senior Forester, Bureau of Forestry, Manila, Philippines; Univ. of Philippines, B.S., (Forestry), 1949.

Lee, M., Senior Forester, Comm. for Ta Shu Shan Forestry, Taipei, Taiwan; Natl. Hu-Nan Univ., B.S., (Mechanical Engr.), 1946.

Pierre-Louis, C. C., Chief, Pilote Project of Colladere, Dept. of Agric., Damien, Port-Au-Prince, Haiti; Ecole Nationale d'Agriculture, Diploma, (Agronome), 1951.

Kang, S., Senior Engr., Comm. for Ta Shu Shan Forestry, Taipei, Taiwan; Waseda Univ., Tokyo, Japan, B.S., (Mechanical Engr.), 1945.

Forestry News

NEW THREE-AND-THREE-QUARTER-MILLION-DOLLAR LABORATORY. State University College of Forestry at Syracuse University, Syracuse, N. Y., dedicated its new three-and-three-quarter-million-dollar Hugh P. Baker Laboratory building for education and research in forest products on May 2-3, 1957, with two-day ceremonies.

Hugh P. Baker Laboratory Dedicated in New York

The State University College of Forestry at Syracuse University, Syracuse, N. Y., on May 2 and 3 held ceremonies to commemorate the dedication of its new $3¾ million Hugh P. Baker Laboratory which will be devoted to education and research in forest products. Frederick S. Crysler, Container Corp. of America, served as general chairman.

Activities began with a symposium on the afternoon of May 2 entitled "Forest Products in Today's World." Its speakers were Richard E. McArdle, chief of the U. S. Forest Service, S. W. Antoville, president of the U. S. Plywood Company, O. H. Alderks, vice president, Buckeye Cellulose Corporation, and George A. Garratt, dean of the Yale School of Forestry. Clyne Crawford, College of Forestry board of trustees, served as the afternoon's chairman.

A dedication banquet on the evening of May 2 was held in the Hotel Syracuse at which David L. Luke, Jr., president of West Virginia Pulp and Paper Company, was the principal speaker. His subject: "Research in Forest Products in Tomorrow's World." Judge Francis D. McCurn, past president of the College of Forestry board of trustees, William P. Tolley, chancellor of Syracuse University, and Dean Hardy L. Shirley of the College of Forestry discussed the purposes of the laboratory and the history of its planning over the years.

The actual dedication ceremony was held the following morning under the chairmanship of Frank C. Moore, chairman, State University Board of Trustees. Short talks were made by Dean Shirley, William S. Carlson, president, State University of New York, and Averell Harriman, Governor of the State of New York. Dean Emeritus Joseph S. Illick of the College introduced Mrs. Hugh P. Baker and Mrs. Richard N. Wright, respectively, widow and daughter of the late Hugh P. Baker in whose honor the laboratory was named. The ladies formally opened the laboratory to assume its role in the program of the College.

Dr. Hugh P. Baker, who died in 1950, came to the College of Forestry as dean during its first year, 1912. He served as dean from that year until 1920 and again during the period 1930 to 1933. Dr. Baker shaped the school during its formative years and embarked it upon a broad course in forestry education. He established professional training in landscape and city forestry, wildlife management, forest chemistry, pulp and paper, lumber manufacture, and wood processing in addition to forest management training.

Baker Laboratory is located on the West end of the College of Forestry's 21-acre campus. The site, which was donated by Syracuse University, is on the south side of Hendricks Field. The building and its surrounding area take up four acres of land. Including landscaping, equipment, and construction its total cost will approach $4 million. Consisting of a four story section and

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a shop wing, the building has a total usable floor space of 80,000 square feet. In it are to be housed the College's Departments of Forest Utilization, Wood Technology, and Forest Chemistry. The newly organized Cellulose Research Institute, previously reported in the JOURNAL, will also be located here.

The physical plant is divided into four class rooms, 29 faculty offices, 22 graduate offices and laboratories, three libraries, and 70 teaching and research laboratories. Special environmental rooms include five equipped for wood conditioning, 13 temperature-humidity controlled research laboratories, two refrigerated rooms, two vibration-free areas, and 14 explosion-proof rooms.

Laboratory facilities include a specially designed circular sawmill equipped with instrumentation to measure and record forces on the mill during sawing; an automatic, multi-speed, paper coating machine; a veneer and plywood laboratory equipped with 54-inch lathe, veneer clipper, steam heated veneer dryer, veneer splicer, and plywood press. Five separate kilns of varying design and heat sources supply teaching and research facilities in kiln drying. The wood preservation laboratory has five impregnating cylinders, and the wood working laboratory a variety of machines. The largest of four universal testing machines has a 400,000 pound capacity. An electron microscope with a magnifying power of 400,000x is, according to the College, the only one of its kind in a wood science center in the United States.

Extensive facilities for basic research in the chemistry and physics of wood, modern equipment for applied research in wood technology, and an admirable physical plant designed for adaption to changing needs make the Hugh P. Baker Laboratory an outstanding development in the field of wood products education and research in the United States. Foresters and wood technologists alike may look forward to the contributions from this laboratory in training future workers and in new and better uses of wood and wood products and therefore to an increasingly vital role to be played in our nation's economy by the forests of the future.

Deputy Assistant Chief for Research Named; Arnold to Head California Experiment Station

George M. Jemison, director of the Forest Service's California Forest and Range Experiment Station since 1954, has been named deputy assistant chief for research for the Forest Service, the U. S. Department of Agriculture has announced.

In this newly created position which he assumes July 1 in Washington, D. C., Dr. Jemison will help plan, direct and coordinate all Forest Service research programs and activities among the Forest Service's nine regional forest and range experiment stations and its Forest Products Laboratory at Madison, Wis.

Appointment of R. Keith Arnold to succeed Dr. Jemison was announced.

Dr. Arnold has been a member of the staff of the California Station for the past six years, and since 1955 has been in charge of its program of forest fire research. In 1954 he served as general manager for "Operation Fire-stop," a cooperative project in which groups joined in an intensive one-year program to explore the possibilities of new techniques in controlling forest fires.

Arnold attended Glendale Junior College and the University of California, where he obtained a B.S. degree in forestry in 1937. In 1938 he earned his Master's at Yale University and in 1950 received his Ph.D. from the University of Michigan. He entered the Forest Service the same year as a research assistant. In 1939 he joined the staff of the University of California.

During World War II, Dr. Arnold served with the U. S. Navy. In 1946, he returned to the University of California. He is an associate editor of the JOURNAL.

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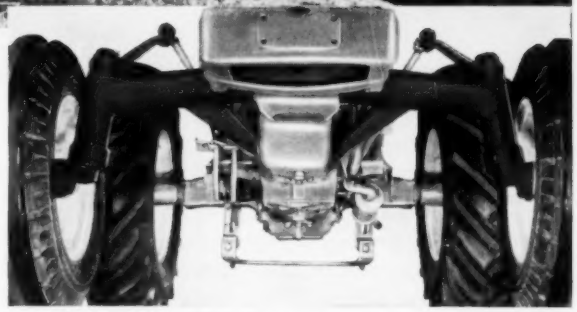

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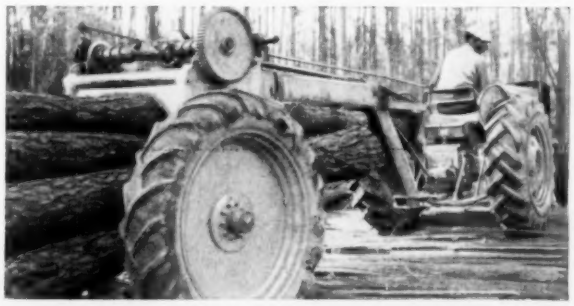

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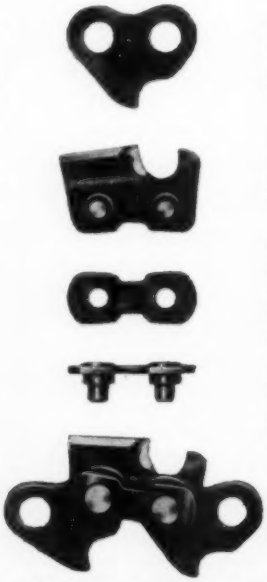

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Colorado A & M College Becomes a University

Effective May 1, the Colorado A & M College at Fort Collins officially became the Colorado State University.

The School of Forestry and Range Management was raised to the status of the College of Forestry and Range Management.

C. H. Wasser is dean of the College.

Utah State to Gain University Status

Utah State Agricultural College announces it has become Utah State University, with the School of Forestry changing its name to the College of Forest, Range, and Wildlife Management.

The curriculum of the College will be expanded. Plans for the future include a new $1,300,000 forestry building and improved facilities for summer camp.

L. M. Turner is dean of the College.

Conference of Biological Science Editors

Under the sponsorship of the American Institute of Biological Sciences, and in part supported by the National Science Foundation, a meeting of biological science journals was held in New Orleans April 2, 3, and 4.

Participants were there by invitation only. About 75 were in attendance.

The JOURNAL OF FORESTRY was represented by Henry Clepper, and *Forest Science* by Stephen H. Spurr.

A proposal was adopted to organize a Conference of Biological Editors which would meet annually to hold workshops and discuss matters of mutual interest. It is expected that the membership of the Conference will total between one hundred and two hundred qualified individuals.

The chairman of the Conference is Bentley Glass, editor of the *Quarterly Review of Biology*, Baltimore. The executive secretary is Fred R. Cagle of *Copeia*, New Orleans.

The Conference voted to apply for membership in the American Institute of Biological Sciences.

Private & Industrial

Blumenstein Joins Tibbals Company Staff

Robert R. Blumenstein has accepted a position with the Tibbals Flooring Company, Oneida, Tenn. where he will be manager of development and manufacturing for a new flooring product.

Before going to Tibbals Mr. Blumenstein was manager of the Timber Engineering Company Laboratory, Washington, D. C. He has also been employed as supervisor of preservative treatments for Koppers Co., Newport, Del.

Mr. Blumenstein is associate editor of *Forest and Wood Utilization* for the JOURNAL OF FORESTRY, and is a member of SAF and Forest Products Research Society. He graduated from Penn State University with a B.S. degree in forestry in 1940.

Tree Planting By Industries Shows Increase

The nation's forest industries planted trees on 256,938 acres of their own lands during the past year, according to official planting figures recently made public.

The forest industry plantings represent 29 percent of all forest tree plantings in the country last year, said James C. McClellan, chief forester for American Forest Products Industries. Also, acreage planted by forest industries is up 7.5 percent over the preceding year, he said. Eighty-four percent of all planting last year involved privately owned lands.

NLMA Executive Named

Mortimer B. Doyle of Chicago, Ill. has been elected executive vice president of the National Lumber Manufacturers Association, NLMA president Walter M. Leuthold announced in April.

Doyle goes to the lumber post from his position as manager of Midwest operations of the National Association of Manufacturers.

He succeeds Leo V. Bodine, who recently resigned from the lumber association to become a vice president of the Diamond Match Co.

As NLMA's chief administrative executive, Doyle will be responsible for activities of the association's headquarters in Washington, D. C., and its field offices in New York, New Orleans, Chicago, and San Francisco.

George Abel Joins Owens-Illinois Glass Company

George W. Abel, former director of forest engineering for St. Regis Paper Co. at Jacksonville, Fla. recently was

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appointed director of technical forestry for Owens-Illinois Glass Co., P. O. Box 1620, Jacksonville.

Mr. Abel is a 1939 forestry graduate of the University of Minnesota. He did graduate work in forest ecology at Cornell University, receiving the M.S. degree in 1941.

Prior to going with St. Regis, he was a research forester for the Southern Forest Experiment Station.

Wolcott Re-Elected Head of Forestry Association

Roger W. Wolcott of Raleigh, N. C. has been re-elected president of the North Carolina Forestry Association.

Mr. Wolcott, area superintendent for International Paper Co. in Raleigh, was also honored recently with an appointment to the North Carolina Forest Industries Committee.

Weyerhauser Advertising Cited

Weyerhaeuser Timber Company and its advertising agency, Cole & Weber, received top honors for their current advertising program when *The Saturday Review's* Fifth Annual Advertising Committee selected a Weyerhaeuser advertisement, one of a series, as "the most distinguished public-interest advertisement of the year."

In its April 20 issue, the magazine had this to say about Weyerhaeuser's advertising program:

"The Number One advertisement of the year, the most distinguished example of advertising in the public interest in the opinion of SR's judges . . . is from the Weyerhaeuser Timber Company's handsome, full-color campaign on behalf of tree farming as the modern method for insuring a permanent supply of wood for America.

"This campaign has not only aided conservation and the efficient use of our timberlands, but has dramatized the importance of regarding trees as crops to be scientifically planted and harvested, thus protecting this country against any future exhaustion of its invaluable timber resources."

Education

Tree Physiologists Meet at Harvard Forest

Thirty plant physiologists primarily interested in tree physiology met April 8 to 12 at the Harvard Forest, Petersham, Mass., for a Symposium on Tree Physiology. The symposium, the first formal gathering of tree physiologists, was sponsored by the Maria Moors Cabot Foundation for Botanical Research of Harvard.

Included in the program were some 35 papers on water relations and sap movement, photosynthesis, general biochemistry, mineral nutrition, photoperiodism and thermoperiodism, and reproduction.

Professor K. V. Thimann and Dr. M. H. Zimmermann were in charge of arrangements for the symposium.

Alumni Groups Honors L. T. Webster

L. T. Webster, supervisor of the Washington Department of Natural Resources, was selected for the 1957 Honored Alumnus Award by the University of Washington Foresters' Alumni Association. The award is given for meritorious service to the profession of forestry and outstanding loyalty to the College of Forestry.

Mr. Webster, the youngest alumnus to be so honored since the award was inaugurated ten years ago, graduated from the University in 1930.

University of California Establishes Colman Memorial

The Colman Watershed Fellowship Fund has been established by the Regents of the University of California to help train graduate students in the field of watershed management.

The aim of the endowment is establishment of the Edward A. Colman Memorial Fellowship, to yield a stipend of at least $2,000 a year. The initial nucleus of the fund consists of $3,252.50, contributed by 125 donors.

The fund which will permit training the much-needed workers was established in memory of Edward A. Colman. Dr. Colman devoted his life to the study of watershed management problems and authored many publications in this field including the book *Vegetation and Watershed Management.* Prior to his death in March 1956 he was chief of the division of watershed management research in the California Forest and Range Experiment Station with headquarters at the University of California, Berkeley.

Contributions to the fund should be made payable to the Regents of the University of California, and addressed to the Colman Watershed Fellowship Fund, School of Forestry, 243 Mulford Hall, University of California, Berkeley 4, Calif.

J. W. Wright Joins Michigan State Staff

The appointment of Dr. Jonathan W. Wright as associate professor of forestry at Michigan State University, effective July 1, was recently announced

JONATHAN W. WRIGHT

by Dr. T. D. Stevens, head of the Department of Forestry.

Dr. Wright attended the University of Idaho, where he received the B.S. (forestry) degree in 1938, and Harvard University, where he received the M.F. and Ph.D. (botany) degrees in 1939 and 1942 respectively.

He started his professional career as instructor of forestry at Purdue University, and since 1946 has been a geneticist at the Northeastern Forest Experiment Station. He is a member of SAF, associate editor of *Silvae Genetics*, and has published widely in the field of forest genetics.

Dr. Wright will be responsible for teaching, particularly at the graduate level, and research in forest genetics and forest tree improvement.

Public

Jorgenson Supervisor of Pinchot Forest

C. Glen Jorgenson has assumed duties as forest supervisor, Gifford Pinchot National Forest, with headquarters in Vancouver, Wash. He replaces Homer J. Hixon who was promoted to the office of the Forest Service in Washington, D. C.

Since 1950, Jorgenson has been a staff officer in the division of Timber Management in the regional office at Portland.

He is a graduate of Washington State College, class of 1939, with a major in range management and is a member of the SAF and the American Society of Range Management.

Experiment Station Gets New Forest Disease Head

Dr. Carl E. Seliskar has recently joined the Central States Forest Experiment Station (U. S. Forest Service) to head up research in the field of forest diseases, according to Dr. William G. McGinnies, director of the Station. Dr. Seliskar went to the Station from Colorado A & M College where he was an associate professor in the Department of Botany and Plant Pathology.

West Coast Forester to Milwaukee Post

Robert W. Appleby of Eugene, Ore. has been promoted to a staff position in the Regional Office of the U. S. Forest Service in Milwaukee.

In commenting on the appointment, Regional Forester A. W. Greeley said, "Appleby will be assigned the special responsibility of being the Region's technical specialist in the selling of national forest timber, and in the administration of timber harvesting operations on the federal forests."

Appleby obtained his training at Mt. Angel College in Oregon, at the University of Washington, and Oregon State College. He entered the U. S. Forest Service in 1939 and has served in various technical and administrative positions on the national forests of the Pacific Northwest.

Gaufin Appointed to Wildlife Management Post in Washington

The appointment of David M. Gaufin of Jackson, Wyo. as assistant to Lloyd W. Swift, chief of the Division of Wildlife Management in the Forest Service, has been announced.

Mr. Gaufin is a native of Murray, Utah. He received a BS degree from the Utah State Agricultural College in 1938.

Following service with the Army during World War II, Mr. Gaufin was supervisor of game management for the Utah Fish and Game Department from 1946 to 1951. He joined the Forest Service in 1951 and has worked as a wildlife biologist in the Intermountain Regional office at Ogden, Utah, and as a forest ranger on national forests in Nevada and Wyoming.

Mr. Gaufin's most recent assignment before coming to Washington was assistant forest supervisor of the Teton National Forest, Jackson, Wyo.

Mr. Gaufin is replacing Everett R. Doman, who has served as assistant chief of the Division since 1954.

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New Oregon Nursery Planned

A state forest nursery that will see an annual seedling production of from 15 to 20 million trees annually is to be established on a 106-acre site near Elkton, Ore., on the Umpqua River, State Forester Dwight L. Phipps has announced.

He added that the project has been made possible through the cooperative efforts of the Douglas county court, the state, and the U. S. Forest Service. The county has purchased the site and leased it to the state with an option to purchase. The Forest Service will advance the major part of the funds for development under the conservation reserve program of the Soil Bank Act. It is estimated that the cost of development, exclusive of the site, will be approximately $250,000.

Dunwoody Named Chief Forester of Rhode Island

Calvin B. Dunwoody has been appointed chief of the Division of Forests, Rhode Island Department of Agriculture and Conservation with headquarters in Providence.

He succeeded Eric Jacobson, chief forester since 1939, who had been acting head of the State Bureau of Markets for the past 18 months.

Mr. Dunwoody is a 1948 graduate of the Yale School of Forestry. As chief of the Division he is also the state forest fire warden.

Henry J. Deion, a service forester, was promoted to the position of deputy chief of the Division.

PROMOTION of Jack H. Wood, supervisor of the Rogue River National Forest, with headquarters in Medford, Ore., to become a staff assistant to the chief of the Division of Cooperative Forest Protection at the headquarters of the U. S. Forest Service in Washington, D. C., was announced in April by Regional Forester J. Herbert Stone at Portland. Wood's promotion became effective June 1.

Pike Forest Supervisor Given New Assignment

Raymond E. Phillips, forest supervisor of the Pike National Forest at Colorado Springs, Colo., transferred to a staff position in the Forest Service regional division of Recreation, Lands and Watershed Management. Regional Forester Donald E. Clark made this announcement, stating that the assignment became effective May 6. Phillip's new duties will include supervising the Rocky Mountain Region's expanded recreation improvement and development program, which is part of the Forest Service's nationwide "Operation Outdoors," aimed at providing adequate campground and recreation facilities in the national forests.

Jess W. Smith, staff assistant of the

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Report of the Committee of Forest Practices, Division of Silviculture, Society of American Foresters, Kenneth P. Davis, *Chairman*.
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Roosevelt National Forest at Fort Collins, Colo., was selected as Phillip's successor, the regional forester said.

New Research Center Leader Named

Robert W. Harris of the Blue Mountain Research Center, LaGrande, Ore., has been named to the position of assistant to the chief of the Division of Range Management of the Forest Service in Washington, D. C.

For the past two years Harris has been research center leader in charge of range, forest, and watershed research.

Merton J. Reed, assistant to the chief of the Division of Range Management Research of the Forest Service in Washington, succeeds Harris as leader of the LaGrande research center, according to Director R. W. Cowlin of the Pacific Northwest Forest and Range Experiment Station.

Economist Appointed to Experiment Station Staff

The appointment of Dr. Thomas C. Adams to the staff of the Division of Forest Economics Research has been announced by R. W. Cowlin, director of the Pacific Northwest Forest and Range Experiment Station, Portland. Adams will devote his time primarily to research in the marketing of forest products.

Adams has been serving as assistant professor of forest management at the School of Forestry, Oregon State College, and as assistant forest economist with the Agricultural Experiment Station at Corvallis.

He received his B.S. degree in forestry from the University of California in 1940. He also holds M.S. and Ph.D. degrees in economics from the University of Michigan.

Arnold to Head State Nursery

C. Ingersoll Arnold has accepted a position in charge of the state nursery at Gerrish, N. H. where he will be concerned with increasing production from two million to ten million trees annually.

Before going to New Hampshire Arnold was director of the Russ Forest and Nursery, maintained by the Michigan State University at Decatur.

He received his AB degree from Bowdoin College in 1939 and an MF degree from Yale University in 1941.

Products & Equipment

Site Preparation Field Day Held

The Brunswick Pulp and Paper Co., Brunswick, Ga., and the Caterpillar Tractor Co. combined forces March 7 to stage a large demonstration of forest site preparation methods. Held on lands of the paper company, over 300 visitors viewed experimental clearing methods including time tests and cost determination. Three major cover type areas of unproductive forest were represented in a total of almost 1,000 acres cleared and prepared for planting.

Methods of clearing test tracts included: harrowing only; raking and harrowing; raking, stumping, and harrowing; raking, shearing, and harrowing; chaining, shearing, and harrowing; and chaining and harrowing. Per acre cost figures compiled during the experiments ranged from $7.30 to $40 for the various types of treatment and machines used. It is stressed by Caterpillar-Brunswick personnel that figures released are for the particular situations involved and can vary with slightly different soil, vegetation, and other conditions.

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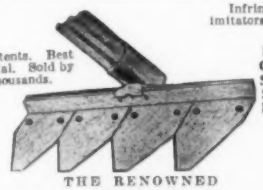

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MOSQUITO
REPELLENT-TISSUE
REPELS MOSQUITOES, GNATS, CHIGGERS, FLIES

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A CATERPILLAR D9 tractor pulls a Rome heavy duty offset harrow in a Forest Site Preparation Field Day sponsored by the Brunswick Pulp and Paper Co. and the Caterpillar Co., near Brunswick, Ga., March 7. Wide interest in site clearing and preparation was evidenced by an attendance of over 300 persons at the field day. *Photo courtesy Caterpillar.*

New Saws Available

McCulloch Motors Corporation, world's largest builder of chain saws, announces a new line of seven saws.

"For 1957, McCulloch offers a choice of gear-driven or direct-drive saws for construction work, road clearing, forestry, tree surgery, and park maintenance," Fred Breer, the company's sales vice president, said, "with a complete selection of size, weight, power, and price."

Leading the new line are the Model D-44 direct-drive saw, which was first introduced last fall, and the all-new Model 55, a 25-pound, gear-driven model that features two adjustable blade positions: one for perfect balance while bucking, the other for low-stump cutting while felling.

In addition, McCulloch offers three accessories: an earth drill, a brush cutter, and an all-purpose drill. The high-speed, portable earth drill can be used for a variety of jobs from fence and sign construction to landscaping. It converts easily to a two-man chain saw. The brushcutter, which weighs less than 28 pounds, cuts brush quickly and easily, and can handle saplings up to six inches in diameter.

Literature on the saws and accessories may be obtained from your local dealer or McCulloch Motors Corporation, Los Angeles 45, Calif.

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Positions Available

Graduate forester, age 32, married. 1 child, veteran. Six years experience in timber and logging management with U. S. Forest Service and private industry in Pacific Northwest. Presently employed. Desire logging management position offering advancement opportunity (prefer plywood or pulp).
Box N, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S. (Forestry) Wash. State College 1950, (Forest Entomology) Duke Univ. 1951. Age 32, married, 3 children. Desires teaching position or work in entomology. Taught forestry at a Junior College for 3 years. Experienced in consulting forestry, federal forest entomology, forester for medium-sized western lumber company, and with the U. S. Forest Service as junior forester and timber marker.
Box O, Journal of Forestry, Mills Building, Washington 6, D. C.

The going is rough here and the rigs are doing two jobs in one, but production averages

AN ACRE AN HOUR

Vredenburgh Alabama Properties have timberland of about 104,000 acres in Monroe and Wilcox Counties, Alabama. This acreage is stocked mainly with loblolly and short leaf pine. The company combines hardwood eradication and control and preparation for natural reseeding in one operation. Key machines for the job are two CAT* D7 Tractors. Equipped with No. 7S Bulldozers and Hyster winches, these units pull heavy-duty Rome harrows. Here you see them working terrain typical of the acreage. Production averages an acre an hour—8 acres an 8-hour day.

Across the country, modern heavy-duty Cat Diesel Tractors are engaged in every type of forest service—plowing firelines, building access roads and piling slash. Their efficiency, stamina and low cost of operation put them out front as producers on any job. Besides the 128 HP (flywheel) D7, there are five models from the 48 HP (flywheel) D2 to the giant 320 HP (flywheel) D9. Whatever your requirements, there's a model that's *right* for them.

Your Caterpillar Dealer, who backs every rugged yellow rig with round-the-clock service, will be glad to give you complete facts about the line. Name the machine and the date—he'll demonstrate!

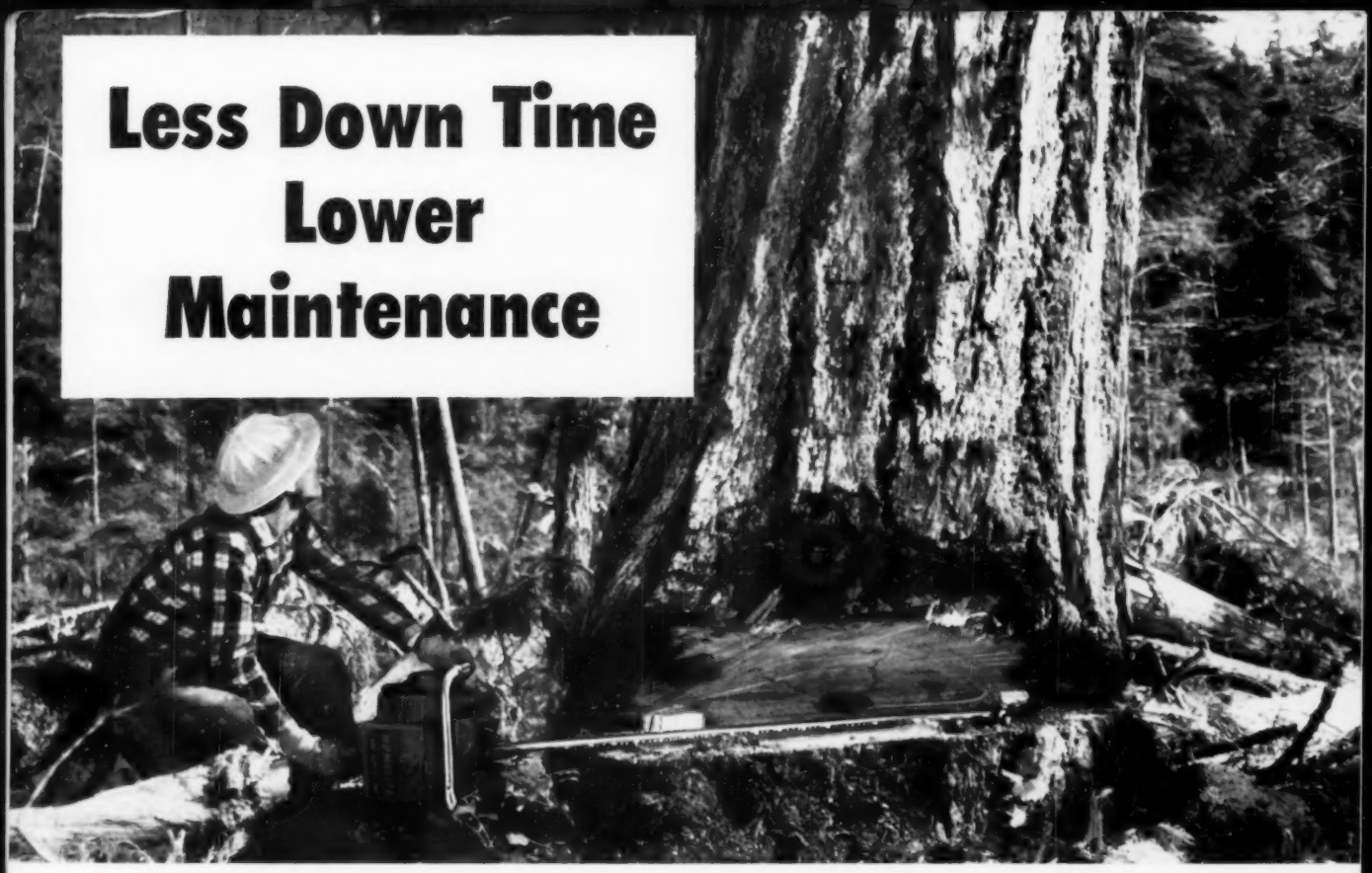
Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

WANTED—
THE HARD WORK

Less Down Time Lower Maintenance



The most powerful one-man chain saw you can own

You get more of the features you want in the Homelite 7-29:

Less down time because the famous Homelite precision design features high-compression, short-stroke engine which prolongs life, cuts gas consumption, starts quickly in any weather.

Lower maintenance with a belt drive that eliminates stretch, never requires adjustment or lubrication; built-in governor keeps engine at proper speeds, stops excessive wear and greatly prolongs life of the saw by reducing vibration, eliminating damage due to engine racing.

More production, greater profits with this powerful Homelite 7-29 that does every kind of cutting needed for high-production operation. Easy to operate, easy to handle, the perfect balance makes every type of cut in any position.

See your Homelite dealer for a free demonstration of the most powerful one-man chain saw you can own — the Homelite 7-29.

7 HORSEPOWER

29 POUNDS

Homelite builds and sells more chain saws than any other company in the world.

COMPLETE LINE OF CHAIN SAWS FOR EVERY CUTTING JOB

Model 17 — an all-purpose saw that brings down trees up to 4 feet in diameter. Available with special brush cutting and clearing attachments for complete versatility. 3½ horsepower, 20 pounds.

Model 5-20 — All the versatility of the 17 with added power. 5 full horsepower — 20 pounds. Brings down trees up to 6 feet in diameter.

Model EZ — lightest, most powerful direct drive chain saw ever developed. Only 19 pounds, full 5 horsepower. Brings down trees up to 3 feet in diameter.

HOMELITE

A DIVISION OF TEXTRON INC

4106 **RIVERDALE AVE., PORT CHESTER, N. Y**

Manufacturers of

carryable pumps • generators • chain saws • blowe

IN CANADA: TERRY MACHINERY CO., LTD.